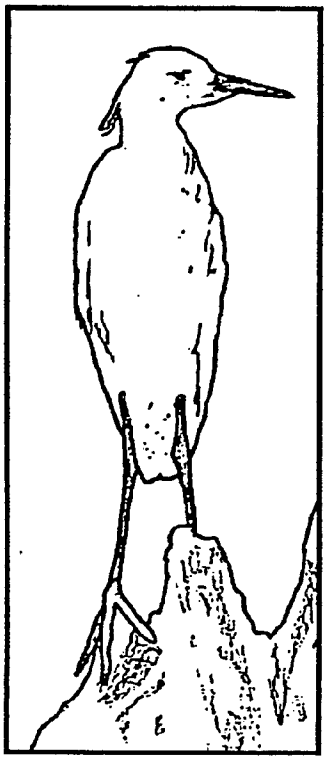


DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

Draft Environmental Impact Statement/ Draft Management Plan

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Ocean and Coastal Resource Management
Sanctuaries and Reserves Division
Washington, D.C.

State of Delaware
Department of Natural Resources and Environmental Control
Office of the Secretary
Dover, Delaware

UNITED STATES

DEPARTMENT OF COMMERCE

DRAFT ENVIRONMENTAL IMPACT STATEMENT

AND

DRAFT MANAGEMENT PLAN

DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

JULY 1991

Prepared by:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service
1825 Connecticut Avenue, NW
Washington DC 20235

State of Delaware
Department of Natural Resources and Environmental Control
Richardson and Robbins Bldg.
Dover, DE 19903

DESIGNATION: Draft Environmental Impact Statement

TITLE: Proposed designation of the Delaware National Estuarine Research Reserve and preparation of a draft management plan.

ABSTRACT: The State of Delaware has proposed designation of two sites (St. Jones River and Blackbird Creek) to form a multiple component Delaware National Estuarine Research Reserve totaling approximately 4000 acres of land and water.

Federal financial assistance for acquisition, development, operations and management will be requested by the State of Delaware. These funds, accompanied by the required 50 percent state match for acquisition and development and 30 percent state match for operations, will be used for basic program activities, including educational and research projects; acquisition of key lands and water; the design, engineering, and site preparation for the DNERR Education and Research Center; and the preparation of a final management plan for the Delaware National Estuarine Research Reserve.

Approval of this proposal would allow for the establishment of a two component estuarine reserve in Delaware representing the Middle Atlantic Subregion of the Virginian Biogeographic Region. The proposed multi-component reserve would be used primarily for education and research purposes, particularly as a tool for improving coastal decision making. No new regulations have been proposed pursuant to this action. Traditional uses within the boundary will continue to be regulated by existing local and state laws and site owner policies. The educational programs will increase public awareness of estuarine resources and their importance. The research plan will establish a baseline monitoring program for the estuarine areas represented by the components, and encourage research projects consistent with the reserve's role as a protected natural field laboratory.

Submit any written comments to the contact identified below.

APPLICANT: State of Delaware, Department of Natural Resources and Environmental Control, Office of the Secretary, Management and Operations.

LEAD AGENCY: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management.

CONTACT: Joseph Uravitch
Chief, Sanctuaries and Reserves Division
Office of Ocean and Coastal Resource Management
National Oceanic and Atmospheric Administration
1825 Connecticut Avenue, N.W., Suite 714
Washington, D.C. 20235

TABLE OF CONTENTS

DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

AICUZ	Air Installation Compatible Use Zone, Dover Air Force Base
BMPs	Best Management Practices, established by the Delaware DNREC
CFR	The Code of Federal Regulations
CZMA	Federal Coastal Zone Management Act of 1972, as amended
DACD	Delaware Association of Conservation Districts
DEIS	Draft Environmental Impact Statement
DMP	Draft Management Plan
DNERR	Proposed Delaware National Estuarine Research Reserve
DNREC	Department of Natural Resources and Environmental Control
DNS	Delaware Nature Society
DRBC	Delaware River Basin Commission
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FMP	Final Management Plan
MOU	Memorandum of Understanding
NEP	National Estuary Program, EPA
NERR	National Estuarine Research Reserve
NERRS	National Estuarine Research Reserve System, NOAA
NMFS	National Marine Fisheries Service, NOAA
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
OCRM	Ocean and Coastal Resource Management, office of, NOAA
SCS	Soil Conservation Service, U.S. Department of Agriculture
SRD	Sanctuaries and Reserves Division, NOAA
UofD	University of Delaware
USFWS	U.S. Fish and Wildlife Service, Department of Interior

DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

DRAFT MANAGEMENT PLAN AND

DRAFT ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY

Section 315 of the Federal Coastal Zone Management Act of 1972 established the National Estuarine Research Reserve System (NERRS), originally called the National Estuarine Sanctuary Program, as a state/federal cooperative venture. Federal matching grants are available to coastal states to develop a national system of estuarine research reserves which are representative of the various regions and estuarine types of the United States. Long term annual NOAA operational grants are available at the ratio of 70% federal and 30% state. In addition, competitive funding for research and education projects is available. The goal of the program is to protect areas of representative estuaries, including valuable wetland habitat, for use as natural field laboratories. National Estuarine Research Reserves are established to: 1) provide opportunities for long-term estuarine research and monitoring; 2) provide opportunities for estuarine education and interpretation; 3) provide a basis for more informed coastal management decisions; and 4) promote public awareness, understanding, and appreciation of estuarine ecosystems and their relationships to the environment as a whole.

The NERRS has adopted a classification scheme that reflects differences in regional biogeography and estuarine typology to ensure that established reserves are representative and that a variety of ecosystem types are included. The Delaware National Estuarine Research Reserve (DNERR) is representative of the Middle Atlantic (Sandy Hook to Cape Cod, excluding the Chesapeake Bay) sub-region of the Virginian biogeographic region.

Governor Michael N. Castle nominated the St. Jones River site and the Blackbird Creek site as components of a multi-site system with the Department of Natural Resources and Environmental Control (DNREC) as the lead agency. Because these two sites are complementary in their representation of the Middle Atlantic biogeographic categories, the State of Delaware recommended that the sites be managed as one Reserve.

For many years DNREC along with the Department of State's Division of Historical and Cultural Affairs have recognized the values of the lower St. Jones River and its surrounding area. The site is only 6 miles from the State capitol of Dover yet it remains undeveloped farm and woodlands as it has been for more than 300 years. However, the upper less brackish reaches of the St. Jones River have been intensely developed, therefore the addition of the upper Blackbird Creek site is a complementing

component to the Reserve. The NERRS was viewed as a compatible tool to provide for natural and cultural resource protection, long-term management and opportunities for research and education.

Boundaries for the proposed DNERR will encompass key land and water areas (or "core area") and a buffer area. The proposed core area includes all of the tidal wetlands of the lower St. Jones River and upper Blackbird Creek sites for a total of approximately 2300 acres. The buffer area includes the lands surrounding the core consisting of wooded fringe, farmed crop and woodlands and freshwater wetlands totaling approximately 1500 acres for the two components. Actual acquisition of core and buffer areas will be less due to the voluntary nature of the program and the expected cooperation of landowners in less than fee simple participation in the Reserve objectives.

The purpose of the proposed DNERR is to establish and manage the Reserve as natural field laboratories and to develop a coordinated program of research and education for the Reserve. Under the preferred alternative, the DNREC fish and wildlife scientists will be brought together with other environmental scientists, educators and managers to operate their estuarine and coastal management programs from a modern Education and Research Center located in the Reserve. A collaborative management approach will be used, involving advisory committees, landowners, private organizations, and local, state and federal agencies. The DNREC will continue to serve as the lead agency.

Proposed Reserve staff will include a program manager, an estuarine educator, a coastal program specialist, and a clerical position. Many others will be located at the DNERR Education and Research Center whose responsibilities will enhance the DNERR objectives through their normal estuarine and coastal management assignments. Other staff that will be located at the Center will have dedicated DNERR assignments that compliment their regular duties including a research coordinator, education coordinator, volunteer coordinator, a resource protection specialist, cultural preservation specialist, folklorist, aquatic coordinator and others, especially visiting researchers.

There will be a major committee composed of representatives of agencies and organizations that have interests in the programs of the DNERR that will serve in an advisory capacity to DNREC on matters concerning resource protection, education, research and monitoring. The DNERR program manager will coordinate administrative functions and operations of the Reserve's programs and act as liaison with state and regional estuarine programs, NOAA and other NERRs.

The Reserve research and education programs will gather and make available information useful for improved understanding, appreciation, and management of estuarine systems especially of the State and Middle Atlantic region. Reserve activities will augment the many on-going conservation and management activities.

Facilities will be developed as necessary to aid in research and education and to serve as a focal point for visitors to the Reserve.

In addition to the preferred alternative, other alternatives are discussed, including no action, alternative sites, alternative boundaries, alternative management strategies, and alternative locations for the proposed DNERR Center.

Under the no action alternative, the Delaware NERR designation would not be pursued. The St. Jones River and Blackbird Creek sites are still listed in the Delaware state-wide land protection program, however other funding and management approaches would have to be devised to protect the current values of these estuarine sites.

Several other sites were considered, however these were rejected in favor of the proposed DNERR St. Jones River and Blackbird Creek sites because of their representative ecological diversity of the Middle Atlantic region, compatible land uses in the buffer areas, and the willingness of the private landowners to participate in the development of the DNERR.

Alternative management plan options were considered, including establishing management of the Reserve within one of the Divisions of DNREC. The uniqueness of the proposed DNERR requires management responsibilities of the Divisions of Fish and Wildlife, Parks and Recreation, Soil and Water Conservation, and Water Resources within DNREC. Therefore it is logical for DNREC Department Management to be the lead agency that will coordinate with its Divisions, the Department of State's Division of Historical and Cultural Affairs and the many other agencies and organizations that will be involved with the operations of the Reserve.

The location of the Education and Research Center was another alternative considered. The St. Jones River site is the preferred location due to its proximity to DNREC Headquarters and other support group offices and facilities.

Valuable natural and cultural resources will be protected for long-term research and education by designation and implementation of the Management Plan. Natural resources affected by the proposed action include diverse, highly productive estuarine systems comprised of tidal and non-tidal wetlands, open waters, with salinities ranging from freshwater to sea strength, and uplands. Several species of either rare, endangered, or threatened plants and animals occur in the proposed Reserve. In addition to such rich diversity of natural resources, the Reserve is also endowed with significant archaeological and historical sites and landscapes.

Traditional uses in the proposed Reserve include commercial and recreational fishing, shellfishing, hunting, trapping, wildlife observation, boating, agriculture, and forestry. The

designation of the DNERR will accommodate traditional uses. The Management Plan is designed to allow these uses on lands acquired for DNERR as long as the safety of visitors and staff is not jeopardized.

The environmental consequences of the proposed action are positive. The primary impacts will be long-term protection of both natural and cultural resources, the construction of an Education and Research Center, and increased, however controlled, public access. The siting of the Center may require mitigation of impacted cultural resources, however no other resource will be irreversibly or irretrievably lost. These special estuarine resources will be provided with long-term protection and will serve both now and in the future as sites for important estuarine education and research.

The DNERR program is voluntary and non-regulatory. The policies and rules that this Plan contains will only affect lands that have been acquired from willing landowners. All other landowners within the area of the Reserve will have their rights respected by the DNERR.

The proposed action is in accordance with all relevant state, local, and federal land use plans, policies and controls for the areas under consideration.

I. PURPOSE OF AND NEED FOR ACTION

The intent of this document is to establish a management plan for the proposed Delaware Estuarine Research Reserve (DNERR) that is agreeable to the landowners of the components, a benefit to the state of Delaware and acceptable to the National Oceanic and Atmospheric Administration (NOAA) for inclusion in the National Estuarine Research Reserve System (NERRS).

The mission of DNERR is to establish natural research areas which are representative of the diversity of coastal ecosystems found within the Mid-Atlantic Region. Valuable natural and cultural resources will be protected for long term research and education by designation of the Reserve. The two components of the proposed Delaware Estuarine Research Reserve will be managed by the Department of Natural Resources and Environmental Control (DNREC) in cooperation with relevant local, state and federal agencies.

This management plan has been developed according to NOAA regulations (15 CFR Part 921), using information derived from specific site information and public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972 (as amended) and the provisions of the Delaware Coastal Management Program.

A. THE NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM (NERRS)

Congress recognized a need to address threats to the country's important and sensitive estuarine areas. The goal of the federal program is to create a system of reserves that represents distinct estuarine ecosystems found nationally, and to manage these reserves for long-term environmental research and education. Although the program is national in scope, individual states are responsible for implementing and administering their own program, with NOAA providing overall coordination.

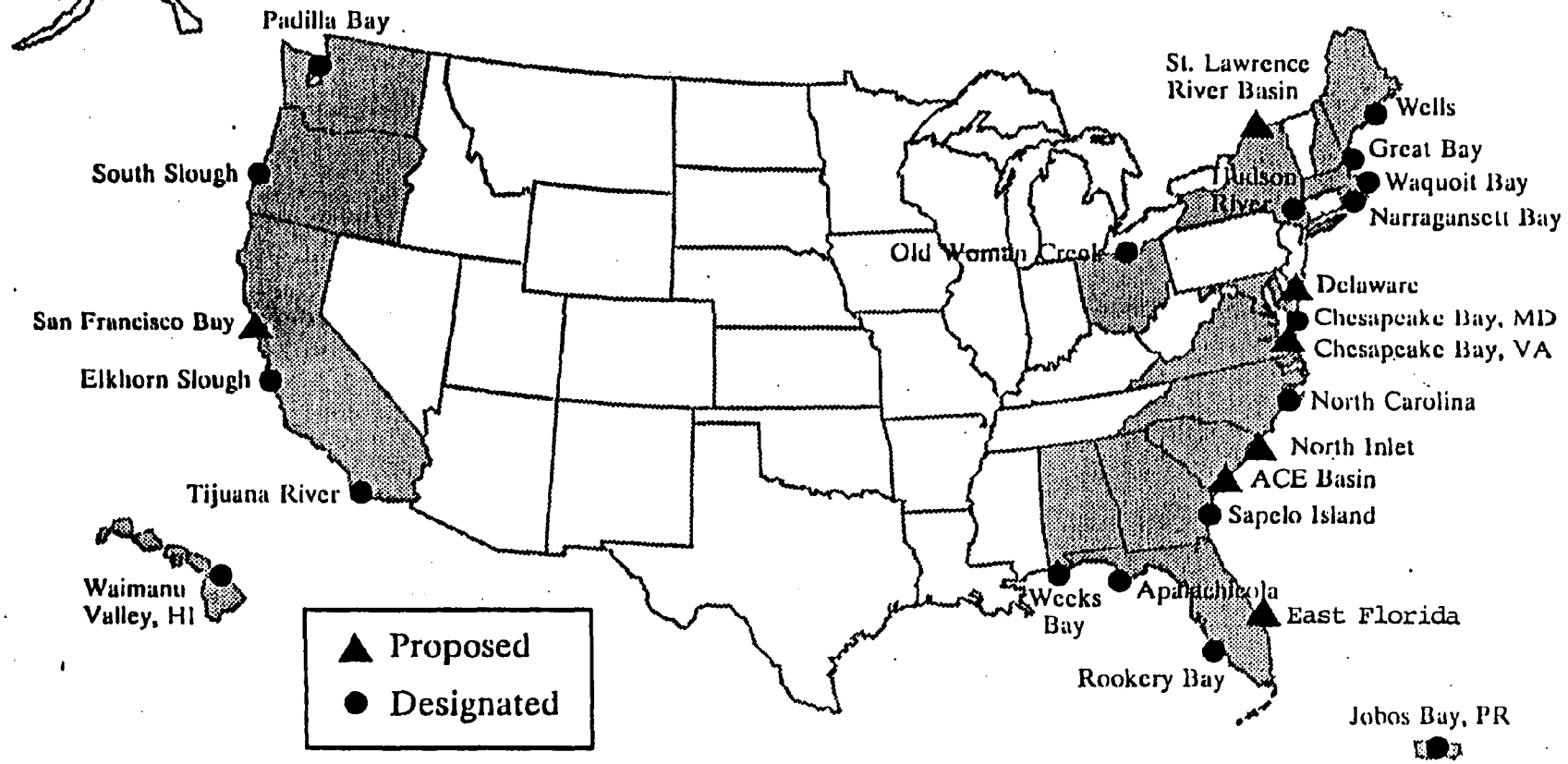
At the present time, 19 NERR Systems have been designated across the country (Fig. 1). Designated Reserves are:

Reserve	Biogeographic Classification
Wells York County, Maine	Acadian
Great Bay Great Bay, New Hampshire	Acadian
Waquoit Bay Mashpee and Falmouth, Massachusetts	Virginian

FIGURE 1

4/90

The National Estuarine Reserve Research System



National Oceanic and Atmospheric Administration
Sanctuaries and Reserves Division
Office of Ocean and Coastal Resource Management
1825 Connecticut Avenue, NW
Washington, DC 20235 (202) 673-5126

continue

Reserve	Biogeographic Classification
Narragansett Bay Newport County, Rhode Island	Virginian
Hudson River Hudson River, New York	Virginian
Chesapeake Bay, Maryland	Virginian
Chesapeake Bay, Virginia	Virginian
North Carolina	Virginian/Carolinian
Sapelo Island McIntosh County, Georgia	Carolinian
Rookery Bay Collier County, Florida	West Indian
Jobos Bay, Puerto Rico	West Indian
Apalachicola River/Bay Franklin County, Florida	Louisianan
Weeks Bay Baldwin County, Alabama	Louisianan
Tijuana River San Diego County, California	Californian
Elkhorn Slough Monterey County, California	Californian
South Slough Coos Bay, Oregon	Columbian
Padilla Bay Skagit County, Washington	Columbian
Old Woman Creek Erie County, Ohio	Great Lakes
Waimanu Valley Island of Hawaii, Hawaii	Insular

Additional NERR Sites are in the designation process for South Carolina, New York, Florida and California.

This draft management plan is consistent with the revised regulations for NERRS which were adopted July 1990. According to the regulations (15 CFR 921), after designation, NOAA will conduct periodic performance evaluations of a reserve at least once every three years. Evaluations may assess all aspects of reserve operation and management, or they may focus on selected issues. Evaluations may also examine whether a reserve is in compliance with NERRS designation regulations, and particularly whether the operations and management of the reserve are consistent with and further the mission and goals of the NERRS.

Federal officials will conduct the performance evaluations. When necessary, NOAA may request federal and non-federal experts to participate in the evaluations. Performance evaluations will be conducted in accordance with procedural and public participation provisions of CZMA regulations. If performance evaluations reveal that the operation and management of the reserve is inconsistent with the DNERR approved Management Plan, the eligibility of the reserve for federal financial assistance may be suspended until the situation is remedied. If major deficiencies are not remedied within a reasonable amount of time, NOAA may initiate a process to withdraw designation of the reserve.

Federal financial assistance for acquisition, development, operations and management will be requested by the State of Delaware. These funds, accompanied by the required 50 percent state match for acquisition and development and 30 percent state match for operations, will be used for basic program activities, including educational and research projects; acquisition of key lands and water; the design, engineering, and site preparation for the DNERR Education and Research Center; and the preparation of a final management plan for the Delaware National Estuarine Research Reserve.

B. THE PROPOSED NERRS PROGRAM IN DELAWARE

Delaware's participation in the NERR System will help strengthen the federal program by establishing the first System located in the NERRS' Middle Atlantic sub-region (Sandy Hook, N.J. to Cape Hatteras, exclusive of Chesapeake Bay) of the Virginian biogeographic region. Nationally, there are 27 biogeographic sub-regions recognized by NOAA's classification system. In terms of benefiting Delaware, the federal NERR System will provide financial assistance awards to the State to acquire, develop and operate estuarine areas as natural field laboratories and environmental education centers. Additionally, a NERRS program in Delaware will help to conserve open, undeveloped spaces, protect valuable resources, and provide areas for outdoor recreation, all done in a manner which accommodates conservation-compatible, traditional resource uses.

Background and History of the NERRS Effort in Delaware

During the early 1980's, the Delaware Department of Natural

Resources and Environmental Control (DNREC) examined the NERR System's precursor, the National Estuarine Sanctuary Program, established in Section 315 of the Coastal Zone Management Act of 1972. While the old Sanctuary Program had several desirable attributes, it did not have enough flexibility or utility within the context of Delaware's resource needs to warrant the State's support. However, during the mid-1980's, the Estuarine Sanctuary Program evolved into today's NERRS program, having a greater emphasis on applied research and environmental education, while allowing more flexibility in the administration of the reserve components to accommodate multiple uses and to respond to management needs. This change occurred when the Coastal Zone Management Act was re-authorized in 1986, in which Section 315 of the Act was changed to the NERRS program with its new emphasis. With this new direction at the federal level, the DNREC again became interested in the program for Delaware, and in 1988 started a pro-active inquiry.

Site Selection Process

Delaware initially identified 16 potential sites for preliminary considerations in the selection process. Based upon environmental representativeness and program utility, the State chose 6 sites for more intensive review. Using intensive site selection criteria, which assessed ecological representativeness, values for environmental research and education, and acquisition and management considerations, a ranking was established for the 6 sites. Information used in the ranking process came from documented sources, field site visits, and professional expertise of the site selection committee members. The top 3 sites were presented to the landowners of the sites and the general public. Primarily from the willingness of the landowners to participate in the NERRS program, 2 sites were selected and nominated to NOAA by Governor Michael N. Castle to be a multiple-site Reserve.

The St. Jones River site was selected to be the primary component of the DNERR. Due to the urbanization of the upper reaches of the St. Jones River, the upper Blackbird Creek site was selected as a second component to provide lower salinity estuarine areas which compliment the St. Jones River component. The minimum area of the components is a representative estuarine ecosystem of the Middle Atlantic subsection of the Virginian Biogeographic Region that is suitable for long term research.

Expectations of Delaware's Proposed NERRS Program

Delaware's participation in the NERRS program will permit the acquisition and long-term management of selected estuarine areas to provide outdoor laboratories for studying ecological structure, functions and processes, and man/land relationships, including both cultural adaptation and the effects of man-induced alterations or stresses. The Reserve will be a valuable laboratory for the two EPA National Estuary Programs in the Mid-Atlantic Region (the Delaware Bay NEP and the Delaware Inland Bays NEP). DNERR components will also serve to educate students

and the general public about the environmental roles and values of estuarine areas. Additionally, the protection of relatively undisturbed natural areas will permit the wise use of these natural resources to continue, typically in association with outdoor recreational activities. The protection of buffer areas which include adjacent uplands will serve to protect significant cultural resources.

Upon NOAA's approval of the Management Plan and successful completion of the NEPA/EIS and Section 106 processes, the final phases of property acquisition, facilities development, and program implementation can begin.

Any lands to be included in the DNERR will be done with the voluntary cooperation of the landowners; there will be no land condemnation procedures associated with the establishment of the Delaware NERR . Lands included in the proposed DNERR may be publicly-owned or publicly-administered properties (at the state, county or municipal levels) and privately-owned properties. The participation of private landowners in helping to manage DNERR sites can take various forms, with the landowner deciding what is best for him/her, whether this decision be based on economics, personal desires for land-use practices and patterns, or both. Private landowner interaction with the DNERR to help activate or participate in the program might consist of fee-simple sale to the DNERR of property at fair market value; other types of property sales to the DNERR (e.g. bargain sale, installment sale, sale with reserved life estate, right of first refusal); various forms of land donations (e.g. outright donation, donation by devise, donation with reserved life estate); dedication as a State Nature Preserve; participation by conservation easements; granting of long-term leases (e.g. 50-year lease); etc.

The Delaware NERR program will be administered by the DNREC in accordance with NOAA and the Federal guidelines. The NOAA agency overseeing the establishment and management of the Delaware NERR is the Sanctuaries and Reserves Division (SRD) of the Office of Ocean and Coastal Resource Management (OCRM) within the National Oceanic Service. Even though the DNERR is composed of two selected components, the sites will still be administered and managed as a single Reserve.

II. PREFERRED ALTERNATIVE

The action under consideration by NOAA is a proposal from the State of Delaware to establish a Delaware National Estuarine Research Reserve consisting of two sites located at the lower St. Jones River (including a segment of the Delaware Bay and its shoreline) in Kent County, and the upper Blackbird Creek in New Castle County.

The two component sites of the Delaware Bay estuary are on the Atlantic Coastal Plain in the Middle Atlantic Subregion of Virginian Biogeographic Region. The Middle Atlantic Subregion

extends from Sandy Hook (at the New York/New Jersey line) to Cape Hatteras (at the Virginia/North Carolina line).

III. MANAGEMENT PLAN PURPOSES

The purpose of the proposed Delaware National Estuarine Research Reserve is to establish and manage the areas within the boundaries as field laboratories and to develop a coordinated program of research and education for the reserve. The Management Plan contains information on the natural, prehistoric, and historic resources of the components; local and regional influences on the components (e.g., climate, hydrology, geology, land use, and population trends); and historical and traditional uses of the components (hunting, fishing, trapping, silviculture, research, education, etc.). In addition, the plan contains a discussion of management issues affecting the reserve and specific policies and activities to address the issues. The policies are resource protection oriented and the activities address needs related to research, monitoring, education, volunteers, public access, administration, facilities development, and acquisition.

The proposed Reserve research and education plans include information necessary for improved understanding, appreciation, and management of the Mid-Atlantic estuarine systems in general. Reserve activities will augment, not replace, the conservation, research, education and other programs of the reserve property owners. Facilities will be developed as necessary to aid in research and education. DNERR access policies will be developed and enforced to protect the integrity of the reserve.

IV. OBJECTIVES AND GOALS

The goals are long-term and somewhat open-ended, focusing on desired conditions rather than specific actions, whereas the objectives are short-term, measurable steps that can be taken to fulfill the goals. The various activities and programs recommended for implementation under this plan are aimed at achieving the objectives.

Resource Protection Goal

Protect the natural and cultural integrity of the ecosystem(s) within the Reserve and associated historic properties from disruptive activities occurring inside and outside of the reserve's boundaries.

Resource Protection Objectives

- Acquire and protect key land and water areas which approximate an entire ecological unit and comprise the research

core and adjacent buffer areas through conservation easements, management agreements, land trusts, or land acquisition.

- Coordinate existing surveillance and enforcement activities and establish a mechanism to increase resource protection, when necessary;

- Provide for adequate public participation as a means to promote compatible uses of the reserve and awareness of the need to protect sensitive resources;

- Rehabilitate reserve habitats where necessary to restore natural bio-diversity and prevent further degradation of resources;

- Promote the protection of historic properties contributing to an understanding of the human processes which have occurred within the estuary; and

- Include historic properties, especially undisturbed areas in land protection decisions.

The objectives will be accomplished by implementing this long-term management plan which is tailored to the components' specific resources and management needs. The Management Plan contains an analysis of management issues, a synopsis of existing laws and regulations which protect the reserve components, and a discussion of DNERR management policies which will add additional resource protection. In addition, DNREC and the Conservation Districts will work with affected landowners to develop site-specific conservation plans which can be implemented through conservation easements, management contracts, or long-term leases. Conservation plans will also be developed for properties donated to or purchased by the State for the reserve program.

Research Goal

Utilize the research reserve for long-term studies to gain a better scientific understanding of natural and human processes occurring within the estuaries and to develop information for improved coastal decision-making.

Research Objectives

- Promote long-term base line studies to characterize flora and fauna within the Reserve and gain an understanding of the ecological interrelationships between organisms and their environments;

- Promote a better understanding of tributary water quality conditions, particularly spatial and temporal dynamics, requirements for growth and survival of living resources, and contribution and effects of point and nonpoint pollution;

- Promote a better understanding of physical processes operating within the estuary, such as tidal influence, circulation dynamics, freshwater inflow, stratification patterns, and sediment dynamics;

- Encourage studies that make effective use of past research and address data gaps in the Reserve's information base;

- Encourage studies that promote a better understanding of human use of the estuaries in the past, including the processes by which human groups have adapted to changes in the estuarine ecology, as well as understanding the changes which have occurred in the estuaries as a result of human activities; and

- Provide for effective use and communication of research results.

The Reserve's components will serve as natural laboratories for field studies in fundamental and applied estuarine sciences and cultural ecology and will provide a linkage between the scientific community and resource managers. The Reserve will be utilized, as appropriate, both for short-term studies to assist in the development of management strategies and long-term studies to improve understanding of ecosystem processes in the Delaware Bay and its tributaries. The Reserve will provide a basis for determining the "health" status of coastal habitats in relation to population growth and development within Delaware and the Middle Atlantic Region.

Education Goal

Enhance public awareness, understanding, and wise use of estuarine resources in the Middle Atlantic Region and encourage an environmental ethic among all users.

Education Objectives

- Promote knowledge of the Reserve, its resources, and its programs as well as knowledge of broader coastal issues and concerns related to estuarine management and protection;

- Provide educational and interpretive services at appropriate Reserve components directly to students, managers and visiting public;

- Use information on past lifeways to make members of the public more aware of the importance of estuarine ecology and to promote balanced use of estuarine resources;

- Promote the preservation of historic properties through public education efforts;

- Provide opportunities for teacher training, student projects, internships, and assistantships where enrollees work

jointly with scientists, gain field experience, and learn about the importance of research resources;

- Provide appropriate facilities which contribute to educational interpretative, volunteer, and research uses of reserve sites; and

- Provide an understanding and appreciation for appropriate traditional uses of the reserve components, including hunting, fishing, trapping, and boating.

The Reserve will be utilized, where appropriate, as outdoor instructional areas for educational studies in estuarine ecology. The reserve program will help foster a long-term commitment to the restoration and protection of the Delaware Bay system and its resources through education about the Bay system, the problems facing it, and the policies and programs designed to help the Bay by providing opportunities for interpretive, recreational, and leisure activities (hiking, bird watching, canoeing, etc.). These activities will be promoted at appropriate reserve sites where the natural area character of the reserve and ongoing research will not be adversely affected.

V. RELATIONSHIP OF DNERR COMPONENTS

A. REGIONAL CONTEXT

The goal of the NERRS Program is to have at least one estuarine reserve representing each biogeographic region of the U.S., and within each region, to represent the major estuarine types found. Currently no other sites exists in the Middle Atlantic region. New Jersey attempted to establish a Reserve along the Mullica River and Maryland had selected potential sites of the Sinepuxent and Chincoteague Bays. None of these sites have been designated.

As the focal component of the proposed DNERR, the Lower St. Jones River estuary has several attributes that are desirable for Regional representation : 1) good access and utility for environmental research and education; 2) a relatively undisturbed tidal marsh representative of the moderate to high salinity emergent wetlands found along the Delaware Coast; 3) adjacent State Wildlife Areas on several sides, permitting studies of manipulative and non-manipulative habitat management techniques; 4) a surrounding upland that surprisingly is still agrarian or forested in nature, presenting opportunities to examine the impacts of agriculture on estuaries; 5) close proximity to the growing City of Dover along the upper St. Jones River, yielding opportunities for the study of man's urbanized impacts on estuarine systems; 6) close proximity to the oyster grounds of the open Delaware Bay; 7) proximity to shoreline segments of Delaware Bay that are crucial foraging habitat for the international migratory shorebird resource; 8) a rich, well documented history of man's use and interactions with the estuary (e.g. the Dickinson Mansion would be part of the DNERR complex); 9) readily available administration and professional management expertise, since DNREC headquarters is within 6 miles and there is good potential to house pertinent DNREC technical personnel at this component and have them assume some of the DNERR management responsibilities as part of their routine duties; 10) good opportunities for outdoor recreation and educational exhibits convenient to a growing metropolis.

The Upper Blackbird Creek estuary component nicely complements the environmental attributes of the Lower St. Jones River estuary, since the Upper Blackbird is primarily a low salinity or freshwater tidal marsh, containing a varied mixture of open water, tidal mud flats, and highly diverse emergent wetlands and forested fringes. Desirable attributes of the Upper Blackbird Creek for the Region include: 1) the area is ecologically representative of the landward ends of many regional estuarine rivers and creeks, and is still relatively undisturbed; 2) contains a high diversity of plant and animal life; 3) aesthetic beauty; 4) provides opportunities for outdoor

recreation in a relatively remote setting; 5) surrounding land use is primarily agricultural, so provides additional opportunities to assess impacts of farmland practices on estuaries; 6) is near extensive stands of Phragmites along the lower Blackbird Creek, so will provide outstanding opportunities for applied research on the biology and control of this problem species; 7) is in close proximity to ecologically interesting, non-tidal forested wetlands, in particular the Delmarva Bays of Blackbird State Forest.

The two sites will be managed as a multi-component Reserve due to the complementary nature of the components. The urbanization of the upper reaches of the St. Jones River estuary caused by the City of Dover limits the opportunity to acquire an ecological unit without the complementary upper Blackbird Creek site. The minimum defined boundaries of the two components together provide the ecologically key land and water areas of the research Reserve.

B. RELATIONSHIP TO OTHER COASTAL PROGRAMS

These two DNERR components are within Resource Areas designated as Lands of State Significance by the Governor's Greenspace for Delaware's Future Committee (1990). Additionally, the Blackbird Creek wetlands have been designated by the U.S. Fish and Wildlife Service, in their draft (1989) Regional Wetlands Concept Plan supplemental to the National Wetlands Priority Conservation Plan (1989) to help actuate the Emergency Wetlands Resources Act of 1986, as priority wetlands for protection and acquisition. The Delaware Estuarine Reserve should also provide opportunities to help strengthen, and in turn be strengthened , by interactions with the Delaware Coastal Management Program and the new EPA/DNREC Delaware Estuary Program, since the Delaware Estuary (River and Bay) was designated by the EPA in 1988 as part of the EPA's National Estuary Program.

C. RELATIONSHIP TO NERRS

Delaware's proposal to establish an estuarine research reserve within the framework of the National Estuarine Reserve Research System provides a means of addressing environmental problems in the State's coastal waters, wetlands and contributing watersheds. A fully implemented DNERR will offer protected components where environmental research and education can focus on natural estuarine processes and man-induced alterations within our coastal habitats, typical of the Middle Atlantic Region. Research and Education projects that are selected will help decision makers in addressing critical coastal management issues. The administrative network that is established under the National Program will promote an exchange of research findings and education efforts for Delaware's estuarine waters, the Middle Atlantic Region, as well as from other estuaries of the United States.

The management plan evaluation and review in this section primarily addresses NOAA's interest in a network of estuarine reserves that are maintained at a level that will be valuable to the national interest in estuary management. The benefit to Delaware in joining this network of reserves is the sharing of estuarine education, research, and management techniques and the grants that are available to a designated reserve that is meeting the intentions of the national program. Because DNREC's interest in estuarine management compliments NOAA's national interest, the reserve program operates as a state/federal partnership. The management of DNERR is the long-term responsibility of DNREC, and NOAA cooperates with and assists Delaware on a regular basis. NOAA will perform formal reviews to ensure that DNREC is in compliance with federal NERRS goals, the Management Plan, and grant work plans.

VI. MANAGEMENT ISSUES

There are issues pertinent to Delaware that are in and around the proposed DNERR that must be recognized and addressed. The Management Plan is based on a strategy that is focused sufficiently to minimize the negative impacts of these particular issues as well as maximizing the positive impacts that many of these issues will provide. The Management Plan also provides the flexibility to address issues that may arise over the long term nature of the Reserve. Following are the current management issues:

- Population Growth
- Highway construction; RT 1 Relief Route;RT 9 & 113 alterations
- Channel alignment & dredging
- Fish & Wildlife management; Hunting, fishing, habitat improvement
- Public access; Restricted areas (e.g. long term research, education, and facility areas)
- Refinement of boundaries; To be determined when management issues are addressed
- Core & Buffer areas delineations; Depends on desired activities and NOAA restrictions per defined activity
- Traditional uses; State owned - DNERR objectives top priority; Easements - Landowners wishes first priority
- Research management on non-state areas will be permissible by concurrence of the private sector first
- Zoning; Land uses: USAFB flight & noise; Wildcat super fund site; City of Dover; Conservation Zones; Agriculture; Sludge & animal waste land/wetlands application
- Maintenance of freshwater flow: State stormwater management law; water quantity/quality
- Maintenance of natural conditions within site designated areas
- Protection of significant natural & cultural resources
- Delineation of research agenda to promote DNERR intent
- Monitor activities

- On-site vs. off-site program
- Representative of Middle Atlantic sub-region
- Need to develop reserve program that provides better management tools for coastal programs
- Research protection activities (Habitat manipulation or alteration)
- Controlled flexibility (all plans need to include desired activities & undesired activities)
- Administrative oversite
- Support long-term studies
- Resource data base
- Link DNERR with scientific community
- Transfer & translation of scientific information to coastal decision-makers & users
- Peer review of proposals and technical reports
- Tailor education, interpretation & other visitor use programs to component needs & constraints
- Coordinate Estuary research, education & cultural efforts in Delaware
- Cultural resources; Cultural resources person needs to be integrated with whole program
- Establish research, education, & cultural center
- Encourage environmental ethic among all estuary users

VII. MANAGEMENT STRATEGY

LOWER ST. JONES RIVER

Research Values

The Lower St. Jones River estuary offers several attractive features for estuarine research, primarily because of its accessibility and the juxtapositioning of an urbanized, developed upper watershed with an agrarian, relatively undisturbed downstream component.

Being adjacent to intensively managed State Wildlife Areas offers opportunities to develop and evaluate habitat enhancement or restoration methods. It is probable that most of the habitat management manipulations would occur on the proactively-managed Wildlife Areas, with much of the proposed DNERR component serving a control function. However, carefully planned and sited habitat manipulations would still occur in the proposed DNERR component on a limited scale for research purposes, or may have to be done to protect or conserve natural resources on the Reserve. Such manipulations would have to be done in context of what areas might be designated core vs. buffer zones within the Reserve's boundaries. It is anticipated that the primary habitat management research topics (on-site or off-site) would focus on the restoration and management of impounded marshes for multiple resource objectives; on mosquito abatement practices; on phragmites control; on management of waterfowl, migratory shorebirds, and upland game species; on muskrat management and furbearer harvest; on management for endangered or rare species; and on the effects of sea-level rise on emergent wetlands. Basic ecological studies on the structure and function of mesohaline-polyhaline emergent wetlands could be an important component of the research program.

Studies on commercial fisheries for blue crabs, oysters, shad, white perch, weakfish, striped bass, and eels could be conducted in the adjacent open waters of Delaware Bay and in the lower end of the St. Jones River. Since June, 1988, a health advisory for human consumption of fish caught in the St. Jones River has been in effect because of PCB contamination in sampled fish tissues. Since the source of this PCB is a mystery, it will be a priority to DNERR researchers. The close proximity of the Reserve component to the major oyster beds of Delaware Bay should make an ideal location for study of this important benthic community type. The primary natural oyster seed beds of Delaware Bay are 10-20 miles north of the mouth of the St. Jones River, while Delaware's leased oyster grounds lie offshore only 2-10 miles north from the River's mouth. Boat access to the open Bay could come from a state-owned dock and ramp at the mouth of the Mahon River (about 8 miles north of the Reserve), or from a state-owned ramp and commercial dock facilities at the mouth of the Murderkill River in Bowers Beach, only 1/2-mile south of the

mouth of the St. Jones River. There is also a state-owned small boat ramp and parking area on the St. Jones River itself, within the proposed Reserve boundaries about 1/4-mile west of Rt. 113 at Barkers Landing. In addition to studies of the Delaware Bay oyster beds, research on the oyster bar community within the most seaward mile of the lower St. Jones River warrants effort, since its decline and degradation mirrors what has happened to the oyster communities at the mouths of almost all tidal rivers and creeks emptying into Delaware Bay, from north of Woodland Beach south to the Broadkill River near Lewes. At present, high bacteria levels keep all of these river- or creek-mouth oysters off-limits for human consumption, and most of the beds do not have high enough densities for commercial harvesting even if consumption was permissible.

An important research program for Delaware that may be housed at the Lower St. Jones River DNERR component is the assessment of the control efficacy and non-target impacts of mosquito control insecticides, either developmental or operational. Such a program would involve "micro-marsh" controlled breeding habitats and hand-application of products, with the research done in conjunction with other agencies and the product manufacturers. Additionally, research projects directed at the mass culture of larvivorous fishes such as Gambusia, or studies of other mosquito control biological agents such as bacteria, fungi or nematodes, would be encouraged.

Research opportunities in the lower St. Jones River basin also exist to assess the impacts of farming practices on the estuary, particularly in terms of non-point source run-off of nutrients, sediments and pesticides, going either into the headwaters of tidal tributaries or into the upper wetlands fringes. New or innovative farm management practices designed to lessen these problems could be implemented and evaluated.

Because of the rich historical and cultural database already existing for the Lower St. Jones River, the component will lend itself to analyses of estuarine impacts or uses associated with many of man's past activities.

With the upper end of the St. Jones River watershed heavily developed by the growing city of Dover, there are excellent opportunities along about a 5-mile segment of the River, just upstream from the Reserve's western boundary, to examine the impacts of urbanization on the estuary. Research emphasis could be given to the impacts of commercial and residential development on non-point source pollution into the headwater tributaries and upper wetlands fringes, particularly from stormwater run-off; on point-source discharge impacts from industry, consisting of a power plant and two manufacturers who do permitted discharging; on aesthetic and associated problems from trash dumping into the wetlands, particularly of old tires and appliances; on groundwater and estuarine surface water pollution problems associated with vertical and lateral leaching from an abandoned landfill (the Wildcat Landfill, a Superfund clean-up site); on

the impacts of state-and-gravel excavation operations occurring in adjacent uplands; etc. A pending $400,000 federal EPA grant to implement a non-point source sediment-and-pollution control plan for the headwater areas above Silver Lake in Dover could be of interest for DNERR monitoring. Silver Lake itself has troublesome problems with bacteria levels, nutrients, and algal blooms.

There may also be an opportunity to do aquaculture research, since the sand-and-gravel excavation business has just initiated an effort to culture hybrid striped bass in some of the company's abandoned borrow pits.

A major asset to the proposed DNERR research program would be the establishment of support facilities on the Reserve component that would house the working offices and laboratories of DNREC professional technical staff. Key field-oriented staff professionals from the Divisions of Fish and Wildlife, Parks and Recreation, Soil and Water Conservation, and Water Resources may have their operational base housed in the Reserve's new support facilities, and as such could easily become directly involved, for a portion of their time, in the DNERR research programs for a wide range of activities (e.g. planning, survey, monitoring, assessment, evaluation, analyses, etc.). Additionally, administrative or technical staff from the Kent Conservation District might also be interested in locating on the Reserve. The potential influx and close association of operational technical personnel with the day-to-day research activities of the Reserve should greatly strengthen the quality, quantity and applicability of the research performed by or through the DNERR program.

Education Values

The Lower St. Jones River estuary, centrally located in Delaware, could become the focus of state environmental/cultural education efforts regarding estuarine systems. The Lower St. Jones River estuary is located approximately 6 miles from Dover, home of both Delaware State College and Wesley College. The Reserve would be about a one-hour drive from either the Newark main campus of the University of Delaware or from the University's Marine Studies Field Complex in Lewes. Additionally, its central location in the State would provide access to varied estuarine environments for elementary and secondary school groups, necessitating no more than a one-hour commute for almost all Delaware schools.

The component includes the John Dickinson Mansion, home to one of Delaware's colonial leaders and signer of the Declaration of Independence. The site, currently owned and operated by the State Division of Historical and Cultural Affairs, is a major interpretive center offering guided tours of the home and grounds. The plantation is a major tourist attraction and is frequented by school groups from throughout the state. The site was visited by a total of 7,194 people from the period June, 1988

to June, 1989, including 95 groups.

Interpretation at the site focuses on the life of John Dickinson as well as the lifestyle and culture of colonial Delaware and America. The St. Jones River served a crucial role during the Colonial period as a vital maritime link with the outside world.

Town Point, site of the oldest known European settlement in Kent County, is located in the Ted Harvey Conservation Area, a state-owned property adjacent to the proposed DNERR component.

The Lower St. Jones River is especially well suited for educational purposes because of its proximity to the Delaware Bay. The adjacent Little Creek Wildlife Area offers access to bayfront beaches suitable for interpretive walks, bird watching, seining and other nature-study activities. The Delaware Nature Society facility at Abbott's Mill near Milford is located approximately 15 miles south from the Lower St. Jones River.

As a DNERR component is established along the Lower St. Jones River, plans would be developed for the construction of a major research/educational center. Similar to the advantages for research efforts, the stationing of DNREC professionals at the Reserve's facilities center could greatly strengthen the operation of the environmental education program. The center would house nature exhibits, aquariums, interpretive displays and literature on estuarine issues, and serve as a base for field tours of the Reserve. Field access facilities such as interpretive trails, boardwalks, and observation towers would be constructed. A center would also serve to complement the existing facilities and exhibits housed at the Dickinson Plantation.

The diversity of habitat, from uplands to tidal marsh and finally beach and open waters of the Delaware Bay, presents a unique outdoor classroom setting and opportunity to provide a holistic view of estuarine systems.

Practical Management Considerations

Traditional Uses

The Lower St. Jones River estuary has a rich, intensive tradition of consumption of renewable natural resources that must be recognized and accommodated by the DNERR program in development of the Management Plan. Waterfowl hunting, upland game hunting, muskrat trapping, and commercial fisheries (e.g. crab and eel potting, gill netting) all occur within the main channel of the St. Jones River, its tributaries, or throughout the contiguous wetlands. The recreational fishing pier at the State-owned St. Jones River Access Area (on the south side of the River, west of Rt. 113 at Barkers Landing) is used by local citizens primarily for crabbing and fishing for white perch and catfish. A private trap-and-skeet shooting club leases several

acres of upland fringe and tidal wetlands adjacent to the Rt. 113 bridge, just to the east of the bridge on the south side of the River. These and other traditional outdoor activities should be accommodated by the Reserve program.

Mosquito Control

Because of the Reserve component's proximity to Dover, and the potential for mosquitoes causing on-site and off-site nuisances and carrying diseases that could cause human illnesses, such as Eastern Equine Encephalitis, saltmarsh mosquitoes that are produced on the Reserve must be controlled. Fortunately, much of the Reserve's tidal wetlands are regularly-flooded habitats where mosquito production is not too severe. However, there are irregularly-flooded zones behind the creekside natural levees or near the upland fringes that necessitate occasional control efforts. When warranted, these areas are treated by the Delaware Mosquito Control Section (part of the Division of Fish and Wildlife) with aerially-applied larvicides before the adult mosquitoes emerge, done at a frequency of 2-6 times per pest season (May-October). Quite infrequently, it may also be necessary to aerially-apply adulticides along the field-and-forest border of the wetlands' upper fringes. Because of the nuisance and human disease problems associated with the far-ranging saltmarsh mosquitoes, these insecticide control efforts must continue within the Reserve after its creation, both within core and buffer zones.

The State is actively pursuing a program to lower its dependence on chemical insecticides to control saltmarsh mosquitoes, by substituting the biological control technique of Open Marsh Water Management (OMWM) as fast as the State's resources and landowner cooperation permit. The environmentally-compatible OMWM technique uses selective excavation of ponds and ditches to usurp ovipositioning sites and to increase larvivorous fish access. In order to reduce the need to use insecticides, the State has included the lower St. Jones River basin for future consideration for OMWM implementation, just as has been planned for many other pest-problem production areas within Delaware's coastal marshes. An additional advantage of the OMWM technique is that a parallel-grid-ditched marsh which is treated with OMWM has wildlife habitat of pools and pannes restored to the marsh that were dewatered by the parallel-grid ditches.

Other pest populations of non-culicid biting flies (e.g. greenhead flies, deer or sheep flies, biting gnats or no-see-ums) occur on the Reserve component, and at times they can be very annoying. However, because of their localized distribution and short flights, they are normally not controlled. This policy may have to be reexamined dependent upon the health problems that establishment and operation of a Reserve program may discover. The use of chemical, biological or mechanical control options will be carefully evaluated for efficiency and impact on non-target species. A baseline for initiation of control activities for non-culicid biting flies may be set based on research at the Reserve.

Phragmites

The rapid spread of phragmites over many areas of Delaware's coastal wetlands has had a net detrimental impact on the quality and quantity of the marsh's resources. While the extent of phragmites cover on the proposed Reserve component is not yet severe, there is the potential that this problem might someday need proactive measures on the Reserve. About 11% of Delaware's coastal wetlands are densely infested with phragmites, and about 1/3 of all of the State's tidal marshes have this species' cover at lower densities. Areas of the adjacent Ted Harvey Conservation Area had unacceptable phragmites incursions and were treated for marsh restoration. If phragmites control is required in order to achieve a balanced representative ecosystem, the State's control program, relying on selective application of glyphosate herbicide followed by prescribed burning, is an option for both core and buffer zones.

Access

Controlling public access to the Reserve component should not be too difficult even though the area is along a linear corridor divided by a river. To the east of Rt. 113, extensive upland buffer zones on both sides of the St. Jones River could be created, since there are only a few property owners and the area is almost exclusively agricultural. On the west side of Rt. 113, the north side of the river has only a few property owners, dominated by the upland sand-and-gravel pit operations. The area of the Reserve where access might be most difficult to control is on the south side of the River west of Rt. 113, where two county roads bring the public right to the River's edge for a portion of the River's frontage.

Boat access to the River corridor itself is somewhat limited, with the main access being a well-used, State-owned ramp for small boats at Barkers Landing, on the south side of the River just west of Rt. 113. The possibility for small boat access from the proposed DNERR facilities center on the River's north side east of Rt. 113, via a natural tributary running from the main channel to a new backmarsh landing, will be thoroughly considered. There is no public access for motorized boats to the River upstream of the Barkers Landing ramp, although Dover residents launch canoes and car-top-style boats from upstream shorelines and from a canoe ramp near Court Street in Dover. Because water depths over the sediment and oyster bars at the River's mouth may be less than a foot at low tide, access into the Lower St. Jones River from Delaware Bay is limited near low tides to only shallow-draft boats.

The use of the River by commercial boats or larger recreational craft is presently limited due to lack of upstream access and downstream shoaling problems. A seven-foot deep channel from Delaware Bay to Dover was completed by the Army Corps of Engineers by 1933, but subsequent dredging was abandoned

because of lack of demand and no place to dump the excavated spoil. There are no current plans or designs for upstream marinas or downstream dredging.

UPPER BLACKBIRD CREEK

Research Values

The diversity of estuarine habitats found in Upper Blackbird Creek, and how they differ from those found at the Lower St. Jones River component, are major attributes for environmental researchers. Some of the least understood estuarine zones, in terms of their ecological structure and function, are brackish and tidal freshwater marshes. The interconnectiveness of upland and marine environments starts in these zones, so a better comprehension of oligohaline-limnetic systems should yield benefits to our overall understanding of estuarine ecosystems. The proposed Upper Blackbird Creek component provides outstanding examples of these transitional habitats.

Other research opportunities within or near the Upper Blackbird Creek component include studies of agricultural practices in terms of their effects on estuarine biota or processes, and studies in land-use planning in terms of contending with burgeoning residential development. In the most seaward portion of the proposed Reserve, and then for several miles downstream of this area, there are some of the State's most dense and extensive phragmites stands, providing substantial opportunities for basic and applied research studies of this problem species. The proximity to complexes of swaled freshwater wetlands, the Delmarva Bays, should be of interest to hydrologists, botanists and herpetologists.

At the present time, research support facilities at the Upper Blackbird Creek component are not being considered (although a modest educational/visitor facility might be developed). Because of the proximity to the Lower St. Jones River component's proposed facilities center (about a 35-minute drive), researchers would commute and use the Upper Blackbird Creek component primarily as a field laboratory. Hydrographic monitoring stations might be established in the lower and upper portions of the component's main channel, consisting of continuously-recording tide gauges to monitor water heights, continuously-recording instruments for salinity and temperature, and rain gauges. Of course, similar hydrographic monitoring stations would be established for the Lower St. Jones River. Research support need that must be developed for Upper Blackbird Creek is an access site(s) for motorized small boats.

Education Values

The Upper Blackbird Creek, located in southern New Castle

County, is an excellent representative of an inland portion of a Delaware Bay tributary. The headwaters of the creek are formed, in part, by some of the state's most valuable and unique freshwater wetlands. With the focus on freshwater wetlands at the state, regional and national levels, the Upper Blackbird area provides an excellent opportunity to highlight these resources through educational and interpretive programs.

The Upper Blackbird Creek could be utilized as a very convenient field trip site for many of the New Castle County school districts, as well as the Delaware Nature Society (DNS). Over 65% of the State's school children are in New Castle County. DNS contracts with the New Castle County schools in providing environmental education experiences. Students often visit Ashland Nature Center, operated by DNS, for interpretive programs. However, the DNS does not offer a center focused on estuarine or marine environments. In addition, DNS coordinates numerous field trips annually to natural areas throughout the state. There may be many opportunities at the Upper Blackbird Creek component to interact with the DNS for educational programs.

Stream Watch, a volunteer program which instructs citizens how to monitor and test surface water quality, is also coordinated by DNS through a grant provided by the Department of Natural Resources and Environmental Control. Major waterways throughout the state have been "adopted" by Stream Watchers who report results of visual observations and tests for oxygen levels to DNREC. The Upper Blackbird, as well as the St. Jones River, could provide excellent opportunities for this type of active citizen involvement.

In terms of serving higher education needs, Upper Blackbird Creek is located about equidistant between the University of Delaware's main campus in Newark and Delaware State College and Wesley College in Dover. The Upper Blackbird Creek component offers estuarine habitat types not found near the University of Delaware's Marine Studies Field Complex in Lewes.

The primary education/interpretive center for the Delaware NERR is to be located at the Lower St. Jones River component. However, a modest educational facility might be established at the Upper Blackbird Creek component for visiting school or environmental groups. Such a facility might consist of a secure, one-room building with a permanent exhibit; an open-sided pavilion with tables and benches; and restrooms.

The establishment of DNERR educational/interpretive facilities, with components on the St. Jones River and Blackbird Creek, should be attractive destinations not only for Delawareans, but also for residents of nearby metropolitan centers such as Philadelphia, Baltimore, Washington, D.C. and Norfolk, all within a 150-mile radius of the proposed DNERR.

Practical Management Considerations

Traditional uses

Several of the management considerations associated with the Lower St. Jones River component also apply to the Upper Blackbird Creek component, and are addressed in the Management Plan. In particular, concerns with accommodation of waterfowl hunting and muskrat trapping are addressed. Because of the components proximity to extensive phragmites stands, a response plan to future unacceptable incursions within the component must be developed. Production of saltmarsh mosquitoes is not too much of a problem because of the brackish and freshwater habitats of upper Blackbird Creek; however, those mosquitoes that are produced can be locally annoying. Other biting flies will occasionally be severe nuisances.

Buffer

The Upper Blackbird Creek component will be divided by Blackbird Creek running through the component's center (similar to the Lower St. Jones River component). Roads at both extreme ends of the Reserve, and another crossing about 2/3 of the way upstream in the Reserve, connects the opposite sides of component. Because of the agricultural nature of most of the uplands surrounding the creek corridor and its emergent wetlands, upland buffer zones of satisfactory size should be able to be established.

Access

Upper Blackbird Creek has very little boat traffic, and what does occur is essentially associated with waterfowl hunting, muskrat trapping, and recreational fishing. Boat access along the entire course of Blackbird Creek is very limited, with only a few unimproved, private access points. There are no expectations of the creek's future use for commerce, both because of its very shallow depths upstream at low tide and the lack of driving economic forces in the adjacent uplands. The creation of a downstream water access area for motorized small boats, in conjunction with a headwaters canoe launch area, are very desirable improvements to consider.

XIII. BOUNDARIES AND ACQUISITION PLAN

A. KEY ECOLOGICAL AREAS

Boundaries for DNERR must include an adequate portion of the land and water areas of the natural system to form an ecological unit and to ensure effective conservation. These areas must be discrete enough to be effectively managed, and large enough to make long-term research possible. To help focus management efforts, site boundaries encompass core and buffer areas.

NOAA's Guidelines for Establishing Proposed boundaries for National Estuarine Reserves define core areas as areas which contain "critical estuarine ecological units for research purposes, encompassing a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary." The core area is "so vital to the functioning of the estuarine ecosystem that it must be under state control sufficient to ensure the long term viability of the reserve for research on natural estuarine processes...[These areas] should encompass resources that are representative of the total ecosystem which, if compromised, could endanger the research objectives of the reserve." A buffer area is defined as an "area adjacent to or surrounding the core and on which the integrity of the core depends. This area protects the core and provides additional protection for estuarine depending species." The buffer area may include an area for research and education facilities.

Site surveys have been conducted to establish boundaries for each DNERR component. Acquisition strategies to establish adequate State control have been established to provide long-term protection for reserve resources within these boundaries. Expenditure of federal and state funds will be minimized by giving priority to non-fee simple acquisition strategies, such as Memoranda of Understanding (MOUs), conservation easements and long term leases when possible. Fee simple acquisition will be used to obtain some privately owned parcels of land. The state will acquire control of land and water areas from willing sellers and participants only. No condemnation procedures will be used.

B. PRIORITY ACQUISITIONS

1. Lower St. Jones

The Lower St. Jones River DNERR component is located in east-central Kent County, approximately 6 miles southeast of downtown Dover (Fig. 2). The proposed maximum DNERR boundaries encompass about 5000 acres, with most of the area east of Rt. 113

(at Barkers Landing), on the north side of the St. Jones River (Fig. 3). The other portion of the component east of Rt. 113 is on the south side of the St. Jones River, extending up Trunk Ditch to Rt. 113, with the remainder of the component on both sides of the St. Jones River west of Rt. 113, extending up Cypress Branch to C.R. 363 (Fig. 3).

ST. JONES SITE BOUNDARIES

The proposed component is between the Logan Lane tract on the east, which forms the state-owned, 2019-acre Ted Harvey Conservation Area and the 176-acre Roberts tract on the west, also part of the State Wildlife Area system managed by the DNREC's Division of Fish and Wildlife. The Wildlife areas proximity to the Reserve will nicely complement the component's conservation, research and educational activities. Whenever or wherever feasible, activities on the State Wildlife Areas can be done in a manner supportive of the NERRS program, as long as the traditional activities, purposes and management practices on the State Wildlife Areas are not hindered or compromised.

The distance along the main channel of the St. Jones River between the Reserve's upstream, western boundary and Delaware Bay is about 5 1/2 miles. The river continues upstream past the proposed landward boundary of the DNERR component for another 5 miles, flowing out of Silver Lake near downtown Dover. The DNERR component would encompass the John Dickinson Mansion (north of the St. Jones River and east of Rt. 113), managed by the Delaware Division of Historical and Cultural Affairs. The component is partially adjacent to the Dover Air Force Base on the north, and the main body of the component is two miles west of the Delaware Bay shoreline. River area to the Bay is included in the component as well as the section of the Delaware Bay from the mouth of the St. Jones north and along the shore boundary of the Logan Lane tract to it's limit along the shore and extending bayward a distance of two miles.

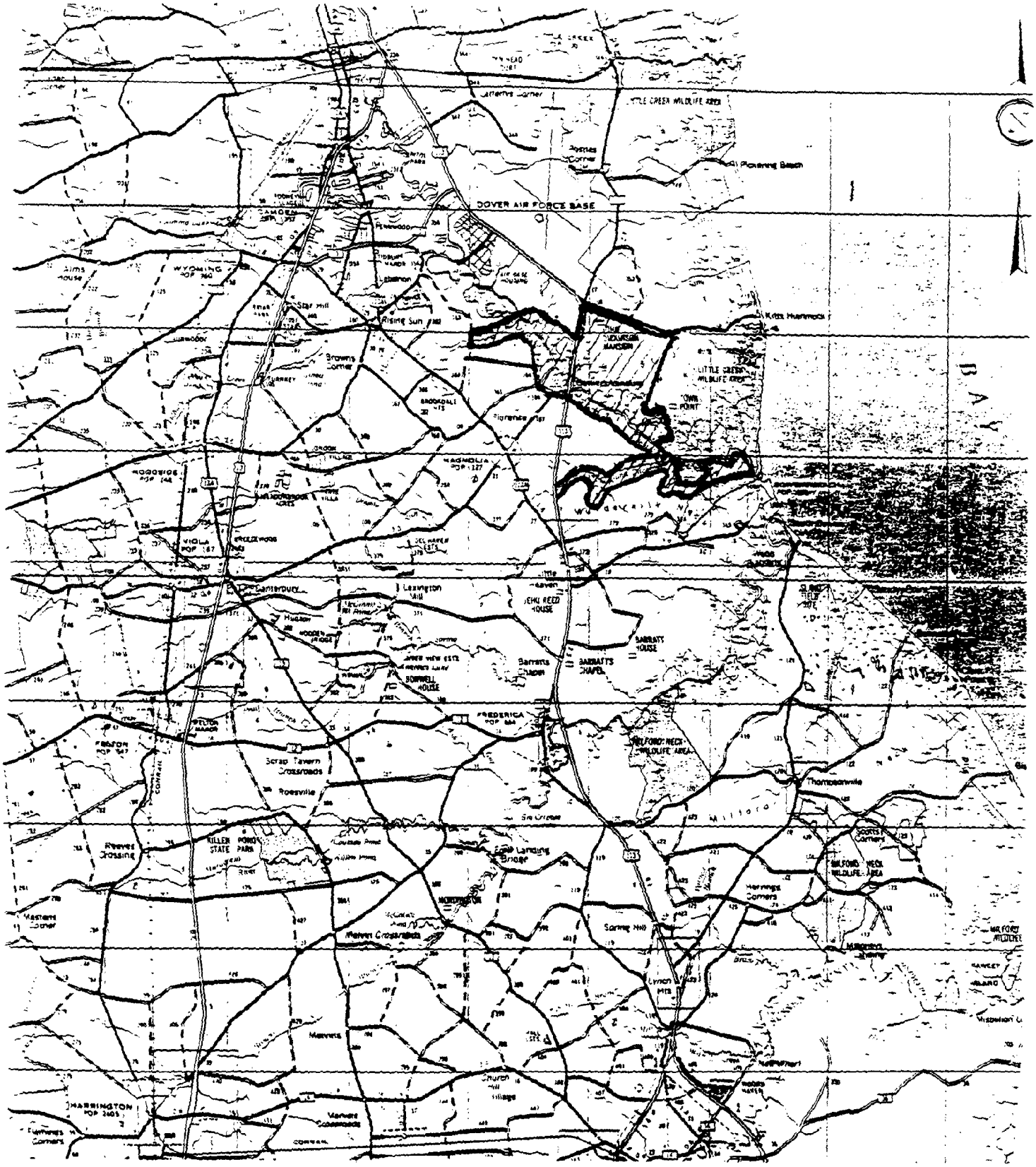


FIGURE 2

General location of the proposed Lower St. Jones River DNERR Component, in east-central Kent County

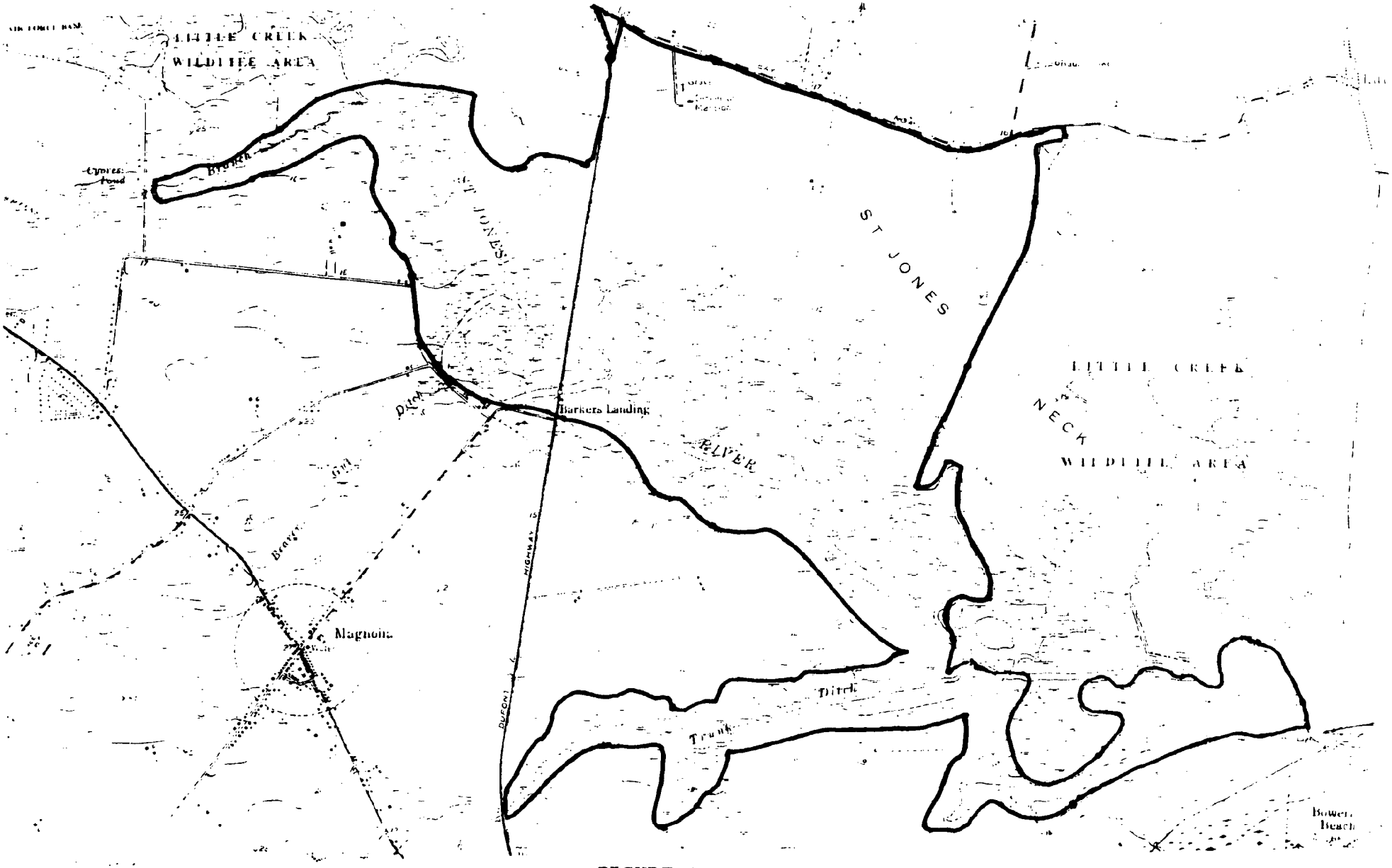


FIGURE 3

Proposed area and boundaries of the
Lower St. Jones River DNERR Component

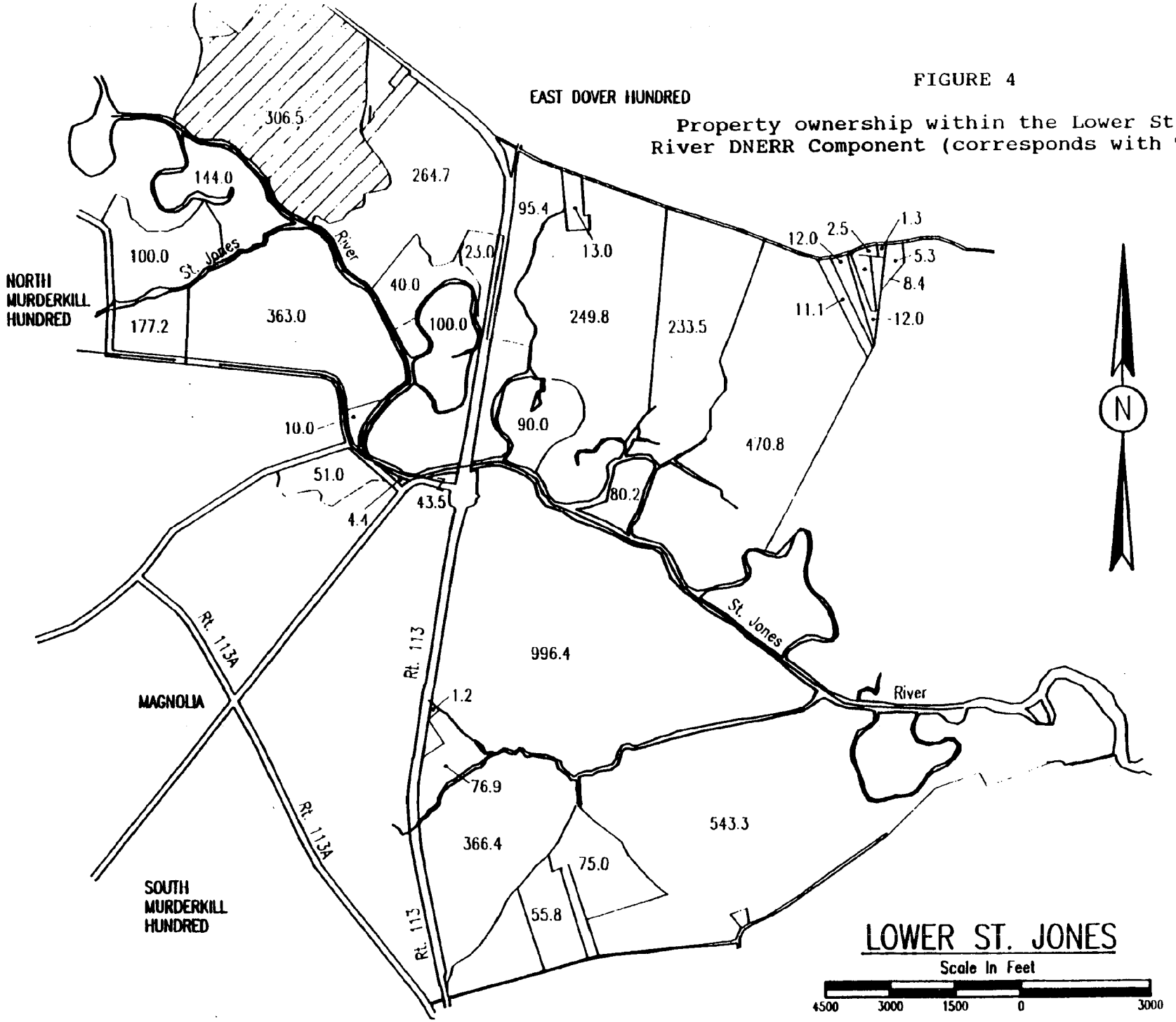
TABLE 1

Land Ownership in Proposed Lower St. Jones River DNERR Component

MAP	PARCEL	ACREAGE	OWNER
East Dover Hundred			
96	20	95.4	Adele Conner, 19 S. State St., Dover, DE 19901
	19	264.7	George & Lynch, Inc., 422 Water Street, P.O. Box 326, Dover, DE 19903
	15	306.5	Delmarva Land Co., 113 W. Sixth St., New Castle, DE 19720
	21	13.0	Historical Society, State of Delaware
106	23	5.3	Thomas B. Farr Estate, P.O. Box 325, Little Creek 19961
	8	1.3	David J. & Sharon Lewis, R.D. 3, Box 189, Little Creek
	7	2.5	Joan M. & Mabel I. Jones, R.D. 3, Box 216-D, Dover
	6	12.0	Robert Clouser, 216 S. Governors Blvd., Dover
	5	8.4	Alexander Auchterlonie, R.D. 3, Box 187, Dover
	3	12.0	FOP
	2	11.1	Delmarva Power & Light, 800 King St., Wilmington 10901
	24	470.8	Alvin Wilson, R.D. 1, Box 363, Dover, DE 19901
	1	233.5	Alvin Wilson, R.D. 1, Box 363, Dover, DE 19901
105	7	249.8	Delagra Corp., P.O. Box 126, Bridgeville, DE 19933
	10	90.0	James McIlvaine, P.O. Box 73, Magnolia, DE 19962
	8.01	23.0	State of Delaware
	8	100.0	King Cole Farms, 207 Hullihen Drive, Newark
	1	40.0	Marjorie Lane, 9 N. Main St., Magnolia, DE 19962
South Murderkill Hundred			
114	1	543.3	Morris, David Vance & Wm. George, R.D. 1, Box 200, Frederica, DE 19946
113	17	76.9	The Island Farm, Inc., 207 Hullihen Dr., Newark
	34	366.4	King Cole Farms, Inc., 207 Hullihen Dr., Newark
	15.01	1.2	Same as above
	16	996.4	Same as above
	43	75.0	John Wilkins, P.O. Box 302, Frederica, DE 19946
	41	55.8	Esther & James Orvis (Lifetime Est., P.O. Box 6, Clayton
105	23	43.5	King Cole Farms, Inc., 207 Hullihen Dr., Newark, DE 19711
	13	4.4	Capitol Office Equipment, P.O. Box 696, Dover, DE 19903
	12	51.0	Henry Zimmerman, R.D. 2, Box 19, Magnolia, DE 19962
	27	80.2	King Cole Farms, Inc., 207 Hullihen Dr., Newark, DE 19711
North Murderkill Hundred			
96	03	100.0	John Farron, 174 Old Mill Road, Dover, DE 19901
	04	144.0	State of Delaware
105	3	10.0	Henry Zimmerman, R.D. 2, Box 19, Magnolia, DE 19962
	2	363.0	Calvin Meyers, R.D. 2, Box 21, Magnolia, DE 19962
	1	177.2	Same as above

FIGURE 4

Property ownership within the Lower St. Jones River DNERR Component (corresponds with Table 1)



Local Interest and Participation

The Lower St. Jones River received the most local support and interest of any site that was examined. Significant interest in the Lower St. Jones River area for its research and educational potential was expressed by both Delaware State College and Wesley College. Letters of support for the Lower St. Jones site were sent by the Principle Planner for Kent County, and by the Mayor of Dover. A joint letter of support for the St. Jones site from the Mayor of Dover and the President of the Kent County Levy Court was sent to Governor Castle. A local historical society, the Friends of Dickinson Mansion, was supportive. Town officials from Bowers Beach expressed interest in having the DNERR program help in land-use planning to conserve rural characteristics along the south side of the lower St. Jones River. The formation of a Lower St. Jones River-DNERR Landowners Management Association, with three property owners elected to serve as Association officers, was quite encouraging. One of the private landowners within the site, an owner of about 700 acres of contiguous key parcels, has expressed a strong interest in helping to establish the program.

Land Ownership

The Lower St. Jones River site boundaries encompass 33 parcels of land representing 22 landowners (Table 1 and Fig. 4). The figure of 5028 acres for this site is a maximum value, since it includes upland areas for parcels containing wetlands where not all of the upland may need to be included in the DNERR component, although some upland area is needed for buffers and support facilities. In terms of percent ownership, 3.3% is owned by the State; 6.1% by a construction company doing sand-and-gravel excavation on its adjacent property; 0.2% by a fraternal organization; 0.3% by an historical society; 33.1% by a corporate farm; 5.0% by another corporate farm; and the remaining 51.8% by 16 private landowners, with four of these private landowners owning 40.8% of the proposed component.

a. Core Areas

The minimum core area of the St. Jones component, which includes a complete egological unit, consists of approximately 50 percent of the estuarine wetland complex located on the north side of the river between the Logan Lane Tract of the Ted Harvey Wildlife Area and Route 113. This complex includes the tidal marshes, tidal creeks and guts, and the open waters. Excepted from this wetland complex is the old wharf site immediately behind the Dickinson Mansion in the edge of the tidal marsh and other areas surrounded by upland.

The maximum core area includes all of the estuarine wetland complex on both sides of the river from the Delaware Bay to the Delmarva Land Company located 1.75 miles west of the Barkers Landing Bridge.

b. Buffer Areas

The buffer areas of the component includes the present agricultural and wooded areas immediately adjacent to the core areas. Included in the buffer areas are the freshwater or tidal marshes surrounded by upland. The old wharf site is part of this buffer. The other areas located south of the St. Jones River east of Route 113 and on both sides of the St. Jones River west of Route 113 will be within the buffer to the core.

c. Ownership and Acreage

There are 33 tracts with 22 owners in the St. Jones area, comprising 5028 acres. The five owners in the core area are being contacted to enlist their cooperation. Two of the five have expressed a desire to work with the State in establishing core and buffer areas.

d. Market values

Market values will be established by appraisal reports in conformance with the "Uniform Appraisal Standards for Federal Land Acquisitions." "Fair Market Value" is defined as the amount in cash, or on terms reasonably equivalent to cash, for which in all probability the property would be sold by a knowledgeable owner willing but not obligated to sell to a knowledgeable purchaser who desired but is not obligated to buy. More than one appraisal may be necessary where negotiations stall. Only appraisers who can meet these standards will be used.

2. Upper Blackbird

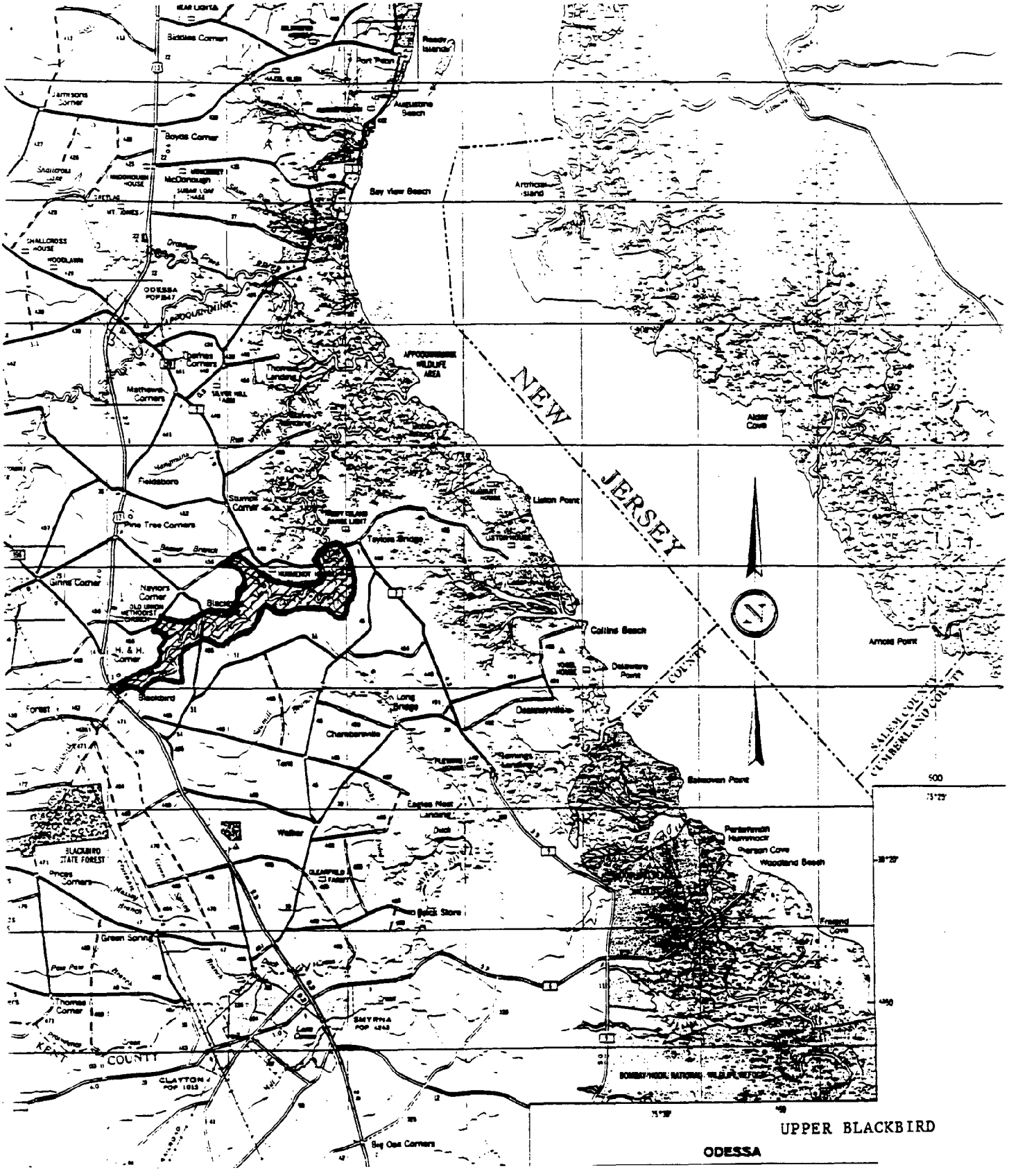
The proposed DNERR component for the Upper Blackbird Creek estuary is located in southeastern New Castle County to the east of Rt. 13, about midway between Odessa to the north and Smyrna to the south (Fig. 5). This component of the DNERR is located about 20 miles (or a 35-minute drive) north of the DNERR focal component on the Lower St. Jones River.

BLACKBIRD COMPONENT BOUNDARIES

The Upper Blackbird Creek component's maximum proposed boundaries encompass about 3800 acres on both the north and south side of Blackbird Creek, from the Rt. 9 bridge at Taylors Bridge upstream to Rt. 13 near Blackbird (Fig. 6). The major tributary of this upper creek segment is Beaver Branch, entering on the north side of Blackbird Creek about midway within the proposed Reserve. The main channel of Blackbird Creek stretches over 5.7 miles throughout the center of the component. Downstream of the seaward end of the Reserve component, from Taylors Bridge to Delaware Bay, the lower Blackbird Creek runs for another 5.8 miles, passing by Red Bank and Stave Landing on its way to the Bay. The upper third of the Reserve is crossed by C.R. 455 at Blackbird Landing.

FIGURE 5

General location of the proposed Upper Blackbird Creek DNERR Component, in southeastern New Castle County



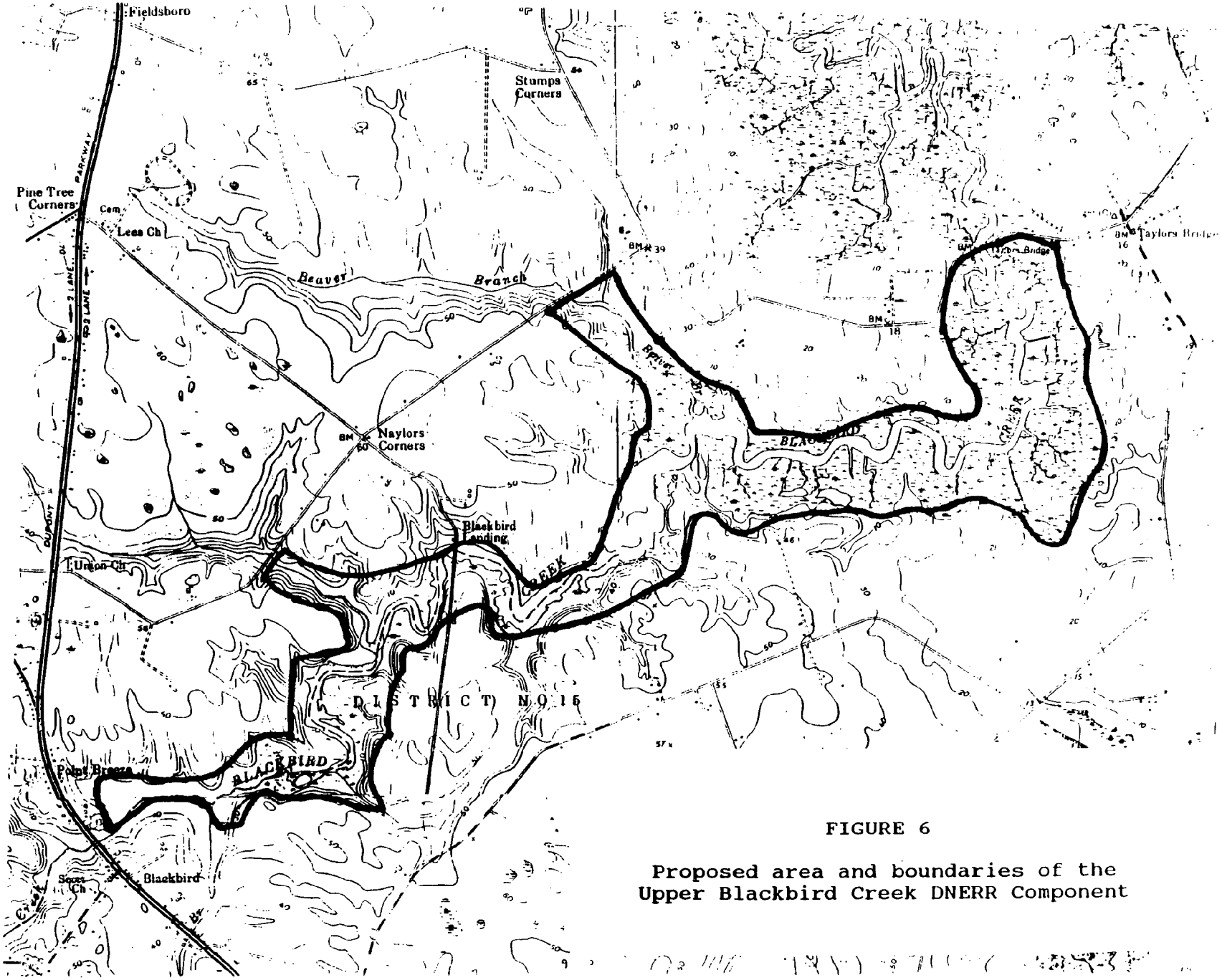


FIGURE 6

Proposed area and boundaries of the Upper Blackbird Creek DNERR Component

Local Interest and Participation

Members of the DNERR Advisory committee were very enthusiastic about Upper Blackbird Creek, since it offers ecological characteristics different from but highly complementary to the Lower St. Jones River component. The entire Blackbird Creek estuary has been recognized by the State Office of Nature Preserve as an outstanding Natural Area worthy of protection. The New Castle County Department of Planning has indicated that the component is appropriate for a NERRS-type of use. A DNERR Landowners Management Association was formed in October, 1989, consisting of three officers who are site landowners who were elected to help in development of the Reserve Management Plan. Finally, a key parcel on the north side of Blackbird Creek, east of Beaver Branch, was purchased by the State (with State funds) in January, 1990, with the intention to make this property an integral part of the Upper Blackbird Creek DNERR. The acquisition of this 211-acre parcel, composed primarily of brackish tidal wetlands with a narrow upland buffer and access strip, was made possible by the cooperation and foresight of Mr. Holger H. Harvey.

Land Ownership

The 3814 acres of the proposed Upper Blackbird Creek DNERR component are divided into 47 parcels owned by a total of 44 landowners (Table 2). Similar to the Lower St. Jones River site, the total acreage figure of 3814 acres is a maximum number, since many of these parcels contain more upland area than what would be needed to provide the creek corridor and adjacent wetlands with adequate buffers. Of the total 3814 acres, Delaware Wildlands, Inc. (a private conservation organization) owns 703 acres (18.4%), and the State of Delaware's new acquisition is 211 acres (5.5%). The remaining 2900 acres are owned privately by 42 landowners; however, only 8 landowners own parcels totaling more than 100 acres per owner, and in aggregate these 8 landowners own 1879 acres (49.3% of the proposed Reserve). Most of the 34 owners of the smaller parcels are clustered around Blackbird Landing or are west of C.R. 455 (Fig. 7).

TABLE 2

Land Ownership in Proposed Upper Blackbird Creek DNERR Component BLACKBIRD HUNDRED

MAP	PARCEL	ACREAGE	OWNER
Blackbird Hundred			
10	54	118.56	Liborio 3 LP, 10th & French St., Wilmington 19801
	50	46.37	Earl Leasure, R.D. 1, Box 362, Townsend 19734
	51	7.16	Richard & Carroll Parsons, 4436 DuPont Hwy., Townsend
11	129	15.03	Douglas D. Pointer, 1507 Greenbriar Rd., Wilmington 19810
	1	11.42	Todd J. Savidge, 1016 Blackbird Landing Rd., Townsend
	135	10.34	Charles J. Benedict, 1014 Blackbird Landing, Townsend
	136	15.51	John I. Ciancio, 1014 Dover Ave., Elsmere 19805
7	57	49.48	John F. Coleman, R.D. 2, Box 31, Middletown 19709
	71	41.77	Charles F. Barton, Jr., 970 Blackbird Land., Townsend
	16	10.29	Harvey W. Straughn, 928 Blackbird Ldng., Townsend 19734
	70	16.97	John W. Bingham, R.D. 1, Box 216B, Smyrna, DE 19977
	69	14.03	William A. Weatherlow, 920 Blackbird Ldng., Townsend 19734
	17	2.40	William C. Shane, 912 Blackbird Ldng., Townsend 19734
	61	2.48	Paul A. Rynkiewicz, 908 Blackbird Ldng., Townsend 19734
	62	2.09	Edward P. Riehm, 904 Blackbird Ldng., Townsend 19734
	63	8.40	Norman Rushton, Jr., 61 Richardson Lane, Wilmington 19804
	64	10.32	Ronald F. Schocie, 786 Eagles Nest Rd., Townsend 19734
	65	12.86	Michael R. Atkinson, 855 Blackbird Ldng., Townsend 19734
	66	7.03	William A. Slawter, 7013 Sellers Ave., Upper Darby, PA
	26	11.28	Lena C. Unruh, 891 Blackbird Ldng., Townsend 19734
	15	24.19	Gerald K. Heinold, Sr., 517 Gumbush Rd., Townsend 19734
	3	231.54	Charles F. Stites, Jr., 617 Gumbush Rd., Townsend 19734
	12	118.59	Vernon E. & Kenneth A. Kershaw, 2612 Grubb Rd., Wilmington
	58	54.38	Vernon E. & Kenneth A. Kershaw, 2612 Grubb Rd., Wilmington
	59	151.03	Same as above
	13	321.18	Mary T. Lynch, Westover Hills, 813 Augusta Rd., Wilmington
	27	3.09	Robert C. Smith, R.D. 1, Townsend 19734
8	1	46.35	Henry J. Stellar, 257 Sawmill Branch, Townsend 19734
	2	192.20	Virginia M. Bell, et al, c/o W. Paul Bradley, 538 Old Summit Bridge, Middletown 19709
3	4	1.22	Mary A. Stellar, Townsend, DE 19734
	5	4.64	Reynolds E. Mercer, 1114 Taylors Bridge, Townsend
4	6	155.58	T. William Lingo, 11 Dodds Lane, Henlopen Acres, Rehoboth Beach, DE 19971
	10	703.40	Delaware Wildlands, Odessa, DE 19730

(continue table 2)
APPOQUINIMINK HUNDRED

Appoquinimink Hundred

MAP	PARCEL	ACREAGE	OWNER
20	83	10.00	Frank Anderson, 4386 DuPont Pkwy., Townsend 19734
16	159	199.38	Corbit D. Collins, 536 Brick Mill Rd., Middletown 19709
	178	27.00	Donald R. Wood, Union Church Rd., R.D. 1, Box 302F, Townsend
	253	28.75	David M. Truesdale, 101 E. Main St., Middletown 19709
	147	57.75	Chester Gove, Jr., 500 Union Church Rd., Townsend 19734
	146	80	George E. Parsons, Rt. 1, Box 298, 556 Union Church Rd., Townsend, DE 19734
17	3	61.57	William J. Cornelius, R.D. 1, Box 158, Smyrna, DE 19977
	5	50.0	Earl Swanson, Odessa KOA Campground, Odessa 19730
	17	85.50	William Manwaring, Box 334, Mendenhall, PA 19357
	11	25.55	Edna M. Windett, 756 Union Church Rd., Townsend 19734
	18	40.35	Hans F. Haug, R.D. 2, Box 150, Landenberg, PA 19350
	6	72.0	David H. Donovan, Box 3210, Smyrna, DE 19977
	7	79.10	Harry Fisher, Jr., R.D. 1, Box 85-A, Townsend 19734
	49	174.20	Holger H. Harvey, Del. Wildlands, Inc., 303 Main St., Odessa, DE 19730
	50	53.3	F. Thomas Unruh, 933 Taylors Bridge, Townsend 19734
	51	211.53	State of Delaware, Department of Natural Resources and Environmental Control, 89 Kings Hwy., P.O. Box 1401, Dover, DE 19903
13	20	11.70	Geoffrey G. Perry, P.O. Box 162, Odessa, DE 19730
	19	25	Elsie & Pauline Shockley, Taylors Bridge Road, Townsend

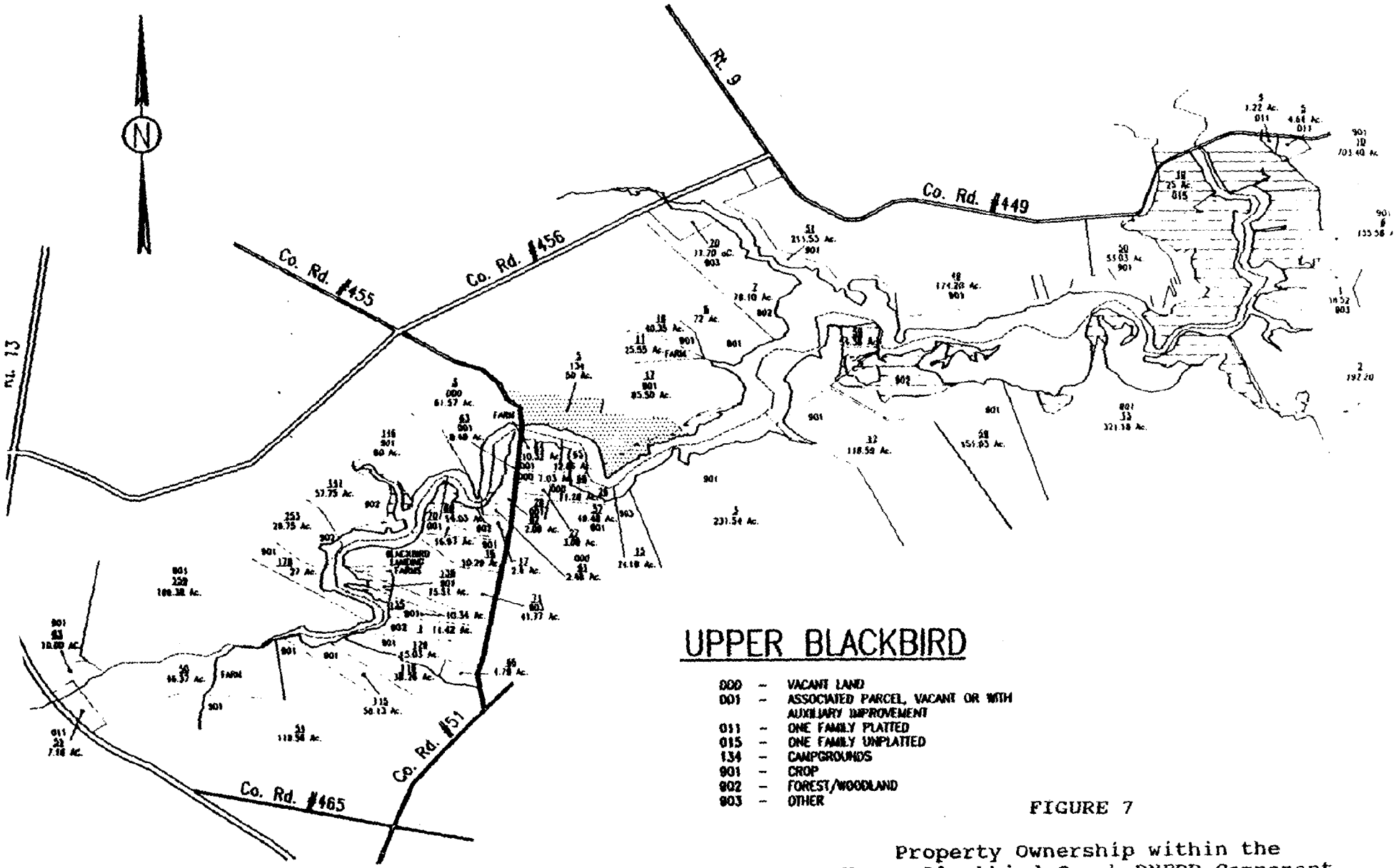


FIGURE 7

Property Ownership within the
Upper Blackbird Creek DNERR Component
(corresponds with Table 2)

a. Core Areas

The minimum core area of the Upper Blackbird, which includes a complete ecological unit, will consist of the tidal marsh, tidal creeks and guts, and the open water of the Blackbird Creek between Taylors Bridge and private lands to the North, the Blackbird Creek to the East and South, and Beaverdam Branch to the West. This core area was acquired by The State of Delaware in January 1990 as a cooperative purchase from the heirs of Louise Nowland.

b. Buffer Areas

The woods along the tidal marsh provide a buffer to the core. Moreover, the uplands immediately adjacent to the woods bounding the core area have been restricted to agricultural use or single family residential use with no residential lot less than 10 acres to ensure little if any impact to the buffer and core areas. The core and buffer areas consisting of 211.53 acres were acquired in fee simple by The State of Delaware for the DNERR program. Additional property interests may be acquired to add to both the core and buffer areas.

c. Market Value

Market values will be established by appraisals in conformance with the "Uniform Appraisal Standards for Federal Land Acquisitions." More than one appraisal report may be necessary to determine the proper market value. Appraisal reports for donations of land will not be required, although an appraisal report may be necessary in negotiating a donation.

C. STRATEGIES FOR ACQUISITION

1. Fee simple

Fee simple title is the acquisition of all rights in the property. Fee simple title will be acquired for the minimum core areas. Through landowner contacts acquisition of the minimum defined core by fee simple title has been determined the only way to ensure the measures required to obtain and maitain the critical estuarine ecological units. Fee simple title will also be acquired for key buffer areas where other lesser property interests cannot be negotiated.

2. Conservation Easement

A Conservation easement (7 Delaware Code, Ch. 69) may be used to restrict the use of a property to its traditional uses and for this program. An owner can retain title to the property and may continue to use the property for any use not inconsistent with this program. Each conservation easement will be tailored to meet the traditional uses and features of the property.

3. Memorandum of Understanding

A Memorandum of Understanding is an agreement between the private owner or other governmental agency and the State to allow the research and education under the DNERR program on property for which no title interest is being acquired. The Memorandum of Understanding must address utilization of the property and run for a term sufficient to complete research projects.

4. Long-term Leases

Long term leases or agreements may be negotiated when easements or other methods of acquisition fail. These leases are intended to extend over a fifty year period to allow sufficient time for research projects to be completed.

5. Alternatives

Rights of first refusal may be negotiated and executed when other commitments from private owners fail. A right of first refusal gives the State an opportunity to meet the purchase price offered by any prospective purchaser of the private land when a change in title occurs. This is an important tool where land has remained in a particular family for a long time, and the owner wants it to remain. This first refusal helps to ensure the opportunity for the State to acquire the land if the ownership changes or the use of the property changes by rezoning or subdivision.

6. Donations

Donations of land should not be overlooked and should be accepted either in fee simple title or conservation easement. In some instances, donations with reserved life estate may be used to incorporate the land into the program while allowing the owner to continue the traditional uses of the property during the owner's lifetime.

D. SCHEDULE

Contact has begun for the core areas in both the St. Jones component and the Upper Blackbird component. The minimum core and buffer areas in the Blackbird component have been obtained with the acquisition of the 211 acre tract in January 1990. Negotiations are ongoing with the owner of 704 acres in the St. Jones component and with the owner of the adjacent 250 acres.

IX. PUBLIC ACCESS PLAN

A. POLICY

Public access shall be permitted on a site specific basis. The objective of regulated access is to maintain each component's integrity for research, long term resource protection, and education while permitting traditional uses which do not conflict with reserve goals.

Entering or remaining on lands under the jurisdiction of the DNERR when such lands are closed or entering or remaining within any building, structure, or facility when such building, structure or facility is closed, shall be prohibited without a written permit from the Reserve Manager.

No structure, facility, building, or area administered by DNERR will be used for any activity other than that for which it was intended without prior written permission of the Reserve Manager.

The Reserve Manager may limit or close specific public use areas, lands, waters, and facilities and/or temporarily prohibit certain activities when such action is deemed necessary for resource management, research, education and/or when it is in the best interest of health, safety, and the general welfare of the public.

B. SPECIFIC COMPONENT ACCESS

1. Public Visitation

St. Jones Component

The general public will be permitted access to outdoor facilities such as trails, boardwalks, etc., from 8 a.m. to dusk on a year round basis, except as restricted for special uses. Access to the John Dickinson Plantation exhibits, etc. will coincide with the regular operation of the mansion as determined by the Division of Historical and Cultural Affairs. General Public Visitation of the St. Jones Center will be from 8 a.m. to 4:30 p.m., Monday through Friday excluding holidays. All access will be for identified facilities only. Free roaming through the component is not permitted without written approval of the reserve manager.

Blackbird Component

The general public will be permitted access to outdoor facilities such as trails and boardwalks from 8 a.m. to dusk on a year round basis, except as restricted for other special uses. These special uses will be posted. All access will be for

identified facilities only. Free roaming through the component is not permitted without written approval of the reserve manager.

2. Group Use

St. Jones Component

All groups should contact the DNERR Estuarine Educator to arrange for programs, guided tours, or other use of the center or Reserve.

Blackbird Component

Groups not needing special program assistance may use the Blackbird component on the same basis as the general public. Groups wishing program assistance must contact the DNERR Estuarine Educator to arrange an appropriate program schedule.

3. Access for boat or canoe launching

St. Jones and Blackbird Components

Access for canoe or kayak launch or retrieval is permitted only in designated locations and during times permitted for general public visitation. Launch or retrieval of other boats by the public is not permitted without written permission of the reserve manager.

4. Fishing, Hunting and Trapping

Traditional activites of fishing, hunting and trapping will be permitted up to levels currently permitted under local and State laws (unless these uses interfere with a research or educational activity that cannot avoid a conflict with these traditional uses).

5. Other Uses

Access for uses other than those listed will be permitted on a case by case basis. The reserve manager's written authorization must be received prior to initiating any of these other uses.

X. ADMINISTRATIVE PLAN

A. ADMINISTRATIVE AUTHORITY

NERR programs are delegated to states under the authority of the federal Coastal Zone Management Act (CZMA) of 1972 as amended. The proposed Delaware NERR program will be administered by the Delaware Department of Natural Resources and Environmental Control (DNREC), Office of the Secretary, Management and Operations. The administrative authority of the CZMA is the U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), Office of Ocean and Coastal Resource Management (OCRM), Sanctuaries and Reserves Division (SRD).

B. STAFF ROLES

1. Administration

The administrative framework for the proposed Reserve recognizes the need for cooperation and coordination in order to achieve the effectiveness of a collaborated developed and implemented Management Plan. The administration for the Reserve ensures that the functions required to implement this plan - education and research activities, land acquisition, facilities development, resource protection - are coordinated with the necessary agencies/organizations/landowners which are presently active within the Reserve's component.

Administrative responsibility for the management of the proposed DNERR is through the Delaware DNREC for several reasons. Wetlands regulations, the Coastal Management and Delaware National Estuary Programs, the Delaware Coastal Management Act, the Beach Preservation Act, the Erosion and Stormwater Management Program, the Non Point Source and Point Source Programs, hunting and fishing regulations, and natural resource management in general are within DNREC and are the obvious reasons for this administrative lead.

Some of the other activities, authorities, and programs that enhance the Reserves values include: the Delaware State Department's Division of Historical and Cultural Affairs for the history, education and research attributes as well as their Museums programs which will address the general public's interest in the Reserve; Wesley College, Delaware State College and the University of Delaware for their Education and Research programs; the Kent County and New Castle County governments for their land use zoning, building codes, recreation programs and other pertinent local authorities; the USDA Soil Conservation Service for their technical services and Plant Materials Center research; the Kent, New Castle and National Conservation Districts programs; the St. Jones and Blackbird Landowners Associations; the St. Jones River Watershed Association; the Delaware Department of Agriculture; and the various environmental and cultural organizations including the Friends of Dickinson Mansion

and the Delaware Nature Society. Many of these groups anticipate co-locating their estuary programs to the DNERR Education and Research Center. This interaction of associated agencies, organizations and governments presents the opportunity for coordination and collaboration. However, it presents an administrative structure that requires defined duties, authorities, and responsibilities of a more disciplined nature than a program that is operated by a single entity.

DNERR ADMINISTRATOR

The Secretary of DNREC is the Administrator of the proposed DNERR. The DNERR program is assigned to the Director of Management and Operations within the Office of The Secretary located at the Richardson and Robbins building within the Capital complex . The DNERR Program Manager is in the Office of The Secretary and is responsible for the overall coordination and operations of the Reserve with the guidance of the Director of Management and Operations. The Program Manager will be located at the DNERR Education and Research Center at the St. Jones component which is only 6 miles from the Capital complex. The State's Staff assigned to the proposed DNERR will be responsible for the Programs of both of the Reserve components.

DNERR EDUCATION AND RESEARCH CENTER

The DNERR Program Manager will be responsible for the Reserve Center operations and maintenance. The Supervisor in charge of each cooperating agency located at the Reserve Center will be responsible for the management and operations of their programs and employees.

VISITORS BARN

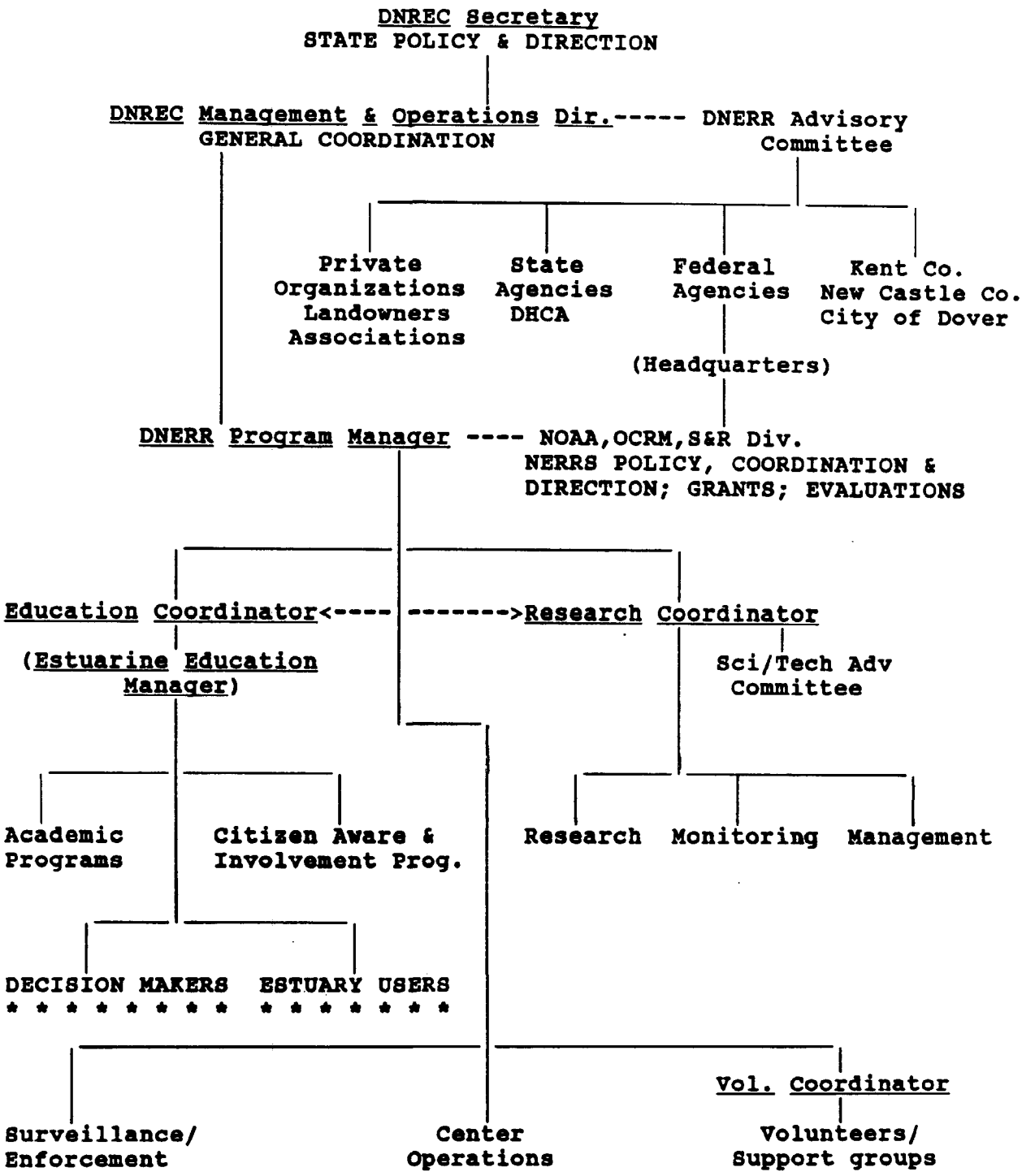
The Department of State's Division of Historical and Cultural Affairs', Bureau of Museums and Historic Sites will be solely responsible for the operations of the Visitors Barn at the John Dickinson Mansion.

AGENCY COORDINATION AND COOPERATION

The development and implementation of the sections of the Management Plan requires the leadership of personnel from four Divisions of DNREC and a Division of the Delaware Department of State. Staff roles are required in research, education and interpretation, and surveillance and enforcement. In addition, staff roles are required to establish and maintain assistance to affected and bordering landowners, to do land acquisition and resources inventories, and to protect and restore valuable resources. The specialists required to perform these functions are important to the degree of success of the DNERR local, regional and national significance. For this reason the authoritative chain of command has been sublimated with a coordinated multi-agency approach that through mutual cooperation has resulted in a collaborative Management Plan with an administrative structure supported by a broad based foundation.

DNERR ADMINISTRATIVE STRUCTURE

The following structure is the authoritative chain that will be followed to resolve conflicts among intra- and inter-agency policies, programs, and directions:



Landowner assistance is aided by the Conservation Districts under the leadership of the DNERR Program Manager and the assistance of the Division of Soil and Water Conservation of the DNREC. This interaction with landowners is very important to the success of the proposed DNERR in that all but 11 acres of the 4000 acres nominated are in private ownership requiring an understanding, cooperation and a willingness of the owners of key lands and waters to voluntarily participate in the program for the Reserve to be established.

The acquisition of land is led by the Real Estate office in the Division of Parks and Recreation of DNREC. This office is responsible for developing and implementing a strategy for adequate long-term state control over the ecologically key land and water areas that have been identified by the Reserve's resource protection, education, research, and facility needs. Through integrating this strategy with the other land acquisition priorities of the DNREC, the Real Estate office will identify ownership, perform negotiations, and carry out settlement responsibilities.

Resource inventories, protection plans, and restoration are the most dependent upon a well developed coordinated staffing approach. Staff assistance is required from DNREC's: Division of Parks and Recreation - Natural Heritage program, Land Preservation, Cultural Resources, and Heritage Planning; Division of Fish and Wildlife - Planning, Wildlife Research, Fisheries Research, Wetlands Research, Waterfowl Management, Wildlife Management, Finfisheries, and Shellfisheries; Division of Water Resources - Wetlands and Aquatic Protection, and Water Quality Management; Division of Soil and Water Conservation - Coastal Management Program, Non Point Source Program, and Conservation Districts. The Department of State's Division of Historical and Cultural Affairs' staff assistance is particularly important to the understanding of the past uses of the Reserve and the collaborative approach to the management of DNERR.

The fish and wildlife scientists are the first series of specialists that are proposed to move into the Education and Research Center. They are the first group that will be provided the opportunity to integrate their normal estuary management functions with the enhancements of the DNERR estuary, research, and education programs.

PROPOSED DNERR STAFF

Pre-designation (Development of Draft Mgmt. Plan/EIS)

- Program Manager (85% time; 100% state funded)
- Research Coordinator (20% time; 100% state funded)
- Education Coordinator (20% time; 100% state funded)
- Realty Specialist (20% time; 100% state funded)
- Res. Prot. Specialist (20% time; 70/30 state/NOAA funded)
- Cult. Pres. Specialist (20% time; 70/30 state/NOAA funded)
- Landowner Assistant (30% time; 100% NOAA funded)

1st year (following plan approval)

- Program Manager (100% time; 100% state funded)
- Research Coordinator (30% time; 100% state funded)
- Education Coordinator (30% time; 100% state funded)
- Estuarine Educator (100% time; 100% NOAA funded)
- Realty Specialist (20% time; 100% state funded)
- Realty Assistant (40% time; 50/50 state/NOAA funded)
- Res. Prot. Specialist (20% time; 70/30 state/NOAA funded)
- Cult. Pres. Specialist (20% time; 70/30 state/NOAA funded)
- Landowner Assistant (30% time; 100% NOAA funded)
- Volunteer Coordinator (30% time; 100% state funded)
- Folklorist (30% time; 100% Interior funded)

PROPOSED DNERR EDUCATION AND RESEARCH CENTER STAFF

2nd year through 5th year

- Program Manager (100% time; 100% state funded)
- Research Coordinator (80% time; 100% state funded)
- Education Coordinator (60% time; 100% state funded)
- Estuarine Educator (100% time; 100% state funded)
- Secretary (100% time; 100% state funded)
- Realty Specialist (20% time; 100% state funded)
- Realty Assistant (40% time; 50/50 state/NOAA funded)
- Res. Prot. Specialist (20% time; 100% state funded)
- Cult. Pres. Specialist (20% time; 100% state funded)
- Landowner Assistant (30% time; 100% state funded)
- Volunteer Coordinator (30% time; 100% state funded)
- CMP Specialist (100% time; 100% NOAA-CMP funded)
- F&W Scientist III (30% time; 100% NOAA-CMP funded)
* - Folklorist (100% Interior funded)
- Project WILD Coordinator (100% NOAA-CMP funded)
- Aquatic Coordinator (100% USF&W funded)
- 3 F&W Program Manager (100% state funded)
- F&W Program Manager (50/50 state/USF&W funded)
- 3 F&W Scientist II (100% state funded)
- 5 F&W Scientist II (100% USF&W funded)
- F&W Scientist II (90/10 state/USF&W funded)
- F&W Scientist II (100% NOAA-CMP funded)
- F&W Scientist I (100% NOAA-CMP funded)
- F&W Scientist I (100% USF&W funded)
- 2 F&W Technician (100% USF&W funded)
- 2 F&W Technician (100% state funded)
- Boat Captain (100% state funded)
- Secretary (50/50 state/USF&W funded)

* This position and all others that follow do not have dedicated time assigned specifically to DNERR projects. Rather these positions present every day assignments that will enhance the Reserve's programs, and the Reserve and the tools that it produces will be valuable to their projects.

2. Research

Research is the foundation of the National Estuarine Research Reserve System. Information must be collected and made available to increase understanding of the processes of estuarine ecosystems and the effects of human activity on these processes. This understanding is essential for the best management of these important ecosystems.

A Research Coordinator designated from the DNREC's Division of Fish and Wildlife will be responsible for research and monitoring activities for DNERR. This staff person is currently located at the field unit in Little Creek along with the other Fish and Wildlife scientists that are proposed to move to the DNERR Education and Research Center. Besides the responsibility of the research activities of DNERR, the Research Coordinator is responsible for coordinating many of the DNREC research activities that would relate to the goals and objectives of NERRS. This will enable the Research Coordinator the best opportunity to integrate many research agenda, maximize the use of the Reserve, and obtain multiple sources of funding for the betterment of the Middle Atlantic estuarine systems.

3. Education/interpretation

The education and interpretation functions are the highest priority of the proposed DNERR program initiatives. An important element is the dissemination of research and monitoring results, and their management implications, to local, state, regional, and national decision makers. Teaching children and adults about the values of estuarine ecosystems and what roles they can have individually and collectively to help protect these important resources is a major undertaking of DNERR and very timely with the needs of environmental education throughout the State of Delaware.

An Education Coordinator will be responsible for coordinating educational and interpretive activities for the DNERR Program. This staff person will be located at the DNREC headquarters until the DNERR Education and Research Center is completed. With Delaware being 95% coastal plain it is important that a State-wide Estuarine Education Program be well developed and integrated if not fore-fronting the State's Environmental Education efforts. It is the responsibility of the Education Coordinator, using multi-sources of funding and leading a multi-agency team, to develop the DNERR Education Program that will be Regionally representative and of National significance to estuarine management. Specifically, under the guidance of the Education Coordinator, an Estuarine Educator will take the lead in initiating the translation and transfer of scientists' research and monitoring results to resource professionals, decision makers and the public.

4. Surveillance and Enforcement

The Delaware Estuarine Reserve staff will provide additional surveillance to and rely on the coordination among state, federal, and local agencies' regulations and authorities to be enforced by the applicable agency for on-site and surrounding areas at least to the extent of the Reserve's watersheds. On-site DNERR staff, capital police of the Department of Administrative Services, and environmental police officers (EPO's) will be responsible for surveillance and will enforce access and activity control according to the Management Plan for DNREC owned lands and to the extent authorized by land owners that have provided access to their properties. Current access control will continue by private landowners.

The core areas will be monitored for the greatest surveillance efforts and maximum enforcement allowable under the rights DNREC will have as the owner of core areas. DNERR staff will limit activities on the buffer areas that would impact the designated core areas in order to maintain the integrity of a naturally influenced estuarine system.

DNERR staff will continue to work with the Delaware Coastal Management Program (DCMP) in order to improve the effectiveness of addressing cumulative impacts of various land use activities. The DCMP's policies and supporting authorities will be important in the enforcement of the DNERR Management Plan.

C. ADVISORY COMMITTEE STRUCTURE AND RESPONSIBILITIES

1. Oversight Committee

The DNERR Advisory Committee is structured to represent many of the Federal, State, County and Local agencies, commissions, societies and organizations that may have an interest, impact or be impacted by the development and management of the proposed Reserve.

The oversight committee will meet at least annually and more frequently as required to represent the cooperating and affected groups of the proposed DNERR.

The DNERR Advisory Committee for the review of the draft Management Plan included representation from the following:

- Delaware Department of Natural Resources and Environmental Control

A. Office of the Secretary
B. Division of Fish and Wildlife
C. Division of Parks and Recreation
D. Office of Information and Education

E. Wetlands Branch
F. Delaware Estuary Program, Div. of Water Resources
G. Division of Soil and Water Conservation

- Office of the Governor, Delaware Development Office

- Dept. of State, Div. of Historical and Cultural Affairs

- Delaware Dept. of Agriculture

- Delaware Dept. of Transportation

- Department of Public Instruction

- NOAA Sanctuaries and Reserves Division, NERRS Program

- County Planners

- Conservation Districts

- Local Federal and City Agencies
  A. Bombay Hook National Wildlife Refuge
  B. U.S. Soil Conservation Service
  C. U.S. Army Corps of Engineers, Phila. District
  D. Dover Air Force Base
  E. City of Dover Planning office

- Academic Community
  A. Delaware State College
  B. University of Delaware
  C. Wesley College

- Citizen Advisory Councils
  A. Advisory Council on Game and Fish
  B. Advisory Council on Tidal Finfisheries
  C. Advisory Council on Shellfisheries
  D. Natural Areas Advisory Council

- Conservation/Environmental Education/Outdoors/Sportsmen Organizations
  A. Wildlife Federation of Delaware
  B. Ducks Unlimited, Inc. (Delaware)
  C. Delaware Saltwater Sportsmen Association
  D. Delaware Mobile Surf-Fishermen, Inc.
  E. Delaware Bass Federation
  F. Delaware Watermen's Assoc.
  G. Delaware State Trappers Assoc.
  H. Delaware Wild Lands, Inc.
  I. Delaware Nature Society
  J. Society of Natural History of Delaware
  K. Delmarva Ornithological Society
  L. Sussex Bird Club
  M. Delaware Audubon Society
  N. Delaware Sierra Club
  O. Delaware River and Bay Shoreline Committee
  P. Delaware Nature Conservancy

- Historical Societies
  A. New Castle Historical Society
  B. Kent County Archaeological Society
  C. Friends of Dickinson Mansion
  D. Daughters of the American Revolution

- DNERR Landowner Associations
  A. St. Jones DNERR
  B. Blackbird DNERR

- DNERR Work Groups
  A. DNERR Facility
  B. Resource Plan Work Group Members

The role of the DNERR Advisory Committee is to provide assistance to the DNERR program in the Decisions required to implement the Management Plan. Assistance will be especially valuable in the operations of the Reserve's programs. The administration of the DNERR Education and Research Center has been structured to accommodate as many estuarine programs of the Advisory and cooperating agencies and groups that would benefit from co-location or shared facility resources.

2. Scientific/Technical Advisory Committee

The DNERR Scientific/Technical Advisory Committee will include representatives from various State and Federal agencies, and the academic and scientific communities. Committee members will provide advice on research and technical matters relevant to the achievements of the DNERR Research goals and objectives. The committee will meet on an annual basis or more frequently at the call of the Research Coordinator to review research proposals and research needs and results for the Estuarine Reserve.

The Scientific/Technical Advisory Committee will include at least eight PH.D. level scientific experts. The scientific experts will be selected from the following disciplines:

- Estuarine hydrographer
- Chemical oceanographer
- Geohydrologist
- Environmental microbiologist
- Wildlife biologist
- Fisheries biologist
- Plankton ecologist
- Benthic ecologist
- Wetlands ecologist
- Soil scientist
- Archaeologist

3. Education/Interpretation Advisory Committee

The Education/Interpretation Advisory Committee will be responsible for providing guidance for the implementation of a

comprehensive estuarine education program, a long outstanding need in Delaware. Most of the respondents to the DNERR facility survey were very interested in the role that the Reserve program and the Education and Research Center could provide to the growing concern for estuary management.

The Education/Interpretation Advisory Committee will be composed of at least eight members which will meet annually or more frequently as needed. These members will be selected from various environmental education interests in the State. These interests include:

- State Office of Environmental Education
- Nature education organization/center
- Elementary level education
- Secondary level education
- College level education
- Adult education
- Cultural education
- Applied environmental education
- Habitat based education
- Teacher training

4. Landowners Associations

The Landowners Associations are made up of property owners within the two DNERR components. They have met during the site selection phase, resulting in the formation of the St. Jones Landowners Association and the Blackbird Landowners Association. An election was held to select officers to represent the component owners.

A Landowner Assistant acts as recording secretary at the DNERR Committee Meetings and then updates landowners about important information through correspondence and newsletters. The Assistant is the contact person within DNREC for the landowners and works through the conservation districts. In this way, the landowners stay abreast of important news concerning the DNERR program.

The Associations have proven invaluable as the most effective and efficient means of communication, decision making, and control from the landowners point of view, the required public involvement, and government needs to develop a Management Plan that will be supported.

D. FEDERAL GOVERNMENT - NOAA REVIEW

The NERRS operates as a federal/state partnership. Although the management of a reserve is a state's responsibility, NOAA cooperates with and assists the states on a day-to-day basis, and reviews state programs regularly. The purpose of the NOAA review

is to ensure that a state is complying with federal NERR goals, approved work plans, and reserve management plans. The primary mechanisms used by NOAA to review state programs, as well as NOAA responsibilities pertaining to reviews, include the following:

NOAA staff, in particular the program specialist for a state's reserve, communicates directly and regularly with state reserve staff. Communication builds a level of trust between federal and state staff, and familiarizes both NOAA and state personnel with reserve management procedures and policies. This cooperative approach is needed for a reserve to be successful. Both oral and written communication are necessary, and site visits are advisable.

Another mechanism available to NOAA is its reserve funding program. NOAA provides different categories of grant funding to a reserve, and for each grant, quarterly progress reports and a final report are required. NOAA personnel carefully review the grant reports and associated communications to ensure compliance with program policies and specific grant conditions.

The site designation process is also a primary avenue through which NOAA reviews actions. A state's site nominations must be assessed and endorsed by NOAA prior to formally beginning the designation process. As part of this preliminary stage, the site selection and public participation process are evaluated by NOAA. When the DMP and DEIS have been completed they must also be approved by NOAA before the final versions of each document are written. NOAA staff have the responsibility of working with the state to select and designate national estuarine reserve sites.

Finally, pursuant to CZMA enabling legislation (Sections 312 and 315), NOAA must conduct performance evaluations of the operation and management of each reserve while federal financial assistance continues. If deficiencies in the operation or types of research conducted at a reserve are found, NOAA may withdraw financial assistance to the reserve until remedies are in place. National Estuarine Research Reserve designation can be withdrawn by NOAA when a reserve is found to be deficient and fails to correct deficiencies within a reasonable time.

XI. ENVIRONMENTAL RESEARCH AND MONITORING PLAN

Estuaries are important to the nation's economy and recreation, and are an integral part of the Earth's environment as a whole. Understanding and protecting this important resource has become increasingly important due to unsound land use practices and the rise of populations in coastal areas, which contribute to the degradation of estuaries. There is a need for management-oriented research to define management strategies which allow multiple uses, but which minimize detrimental environmental and ecological impacts on estuaries.

A major priority of the proposed Reserve is to coordinate, facilitate, and conduct management-oriented research which will provide information useful for local, regional and national coastal management decision making. The creation of permanent field sites for management-oriented research is an important step toward a more comprehensive and integrated program of research, monitoring and management.

The Delaware National Estuarine Research Reserve's (DNERR) two components will expand researchers' opportunities to perform long-term studies in representative ecological zones of the Delaware Estuary. The components provide the opportunity to observe and explain basic functions of and changes in the natural systems, and apply this information to other estuarine systems along the mid-Atlantic coast. These areas will be managed in part to maintain their relatively undisturbed character to serve as controls to compare with other areas, and in part may be modified or manipulated to accommodate research needs and maximize their research utility.

A. GOALS OF ENVIRONMENTAL RESEARCH AND MONITORING

The goals of the Research Reserve's environmental research and monitoring program will be to:

* Establish and manage key (core) areas of the Reserve for long-term use as outdoor field laboratories, maintained for such purpose by the help of buffer areas.

* Coordinate research projects with other research efforts in the Delaware Estuary and Delaware's Inland Bays to streamline scientific efforts, maximize efficient use of resources and funds, and avoid unnecessary duplication of efforts.

* Enhance scientific understanding of estuarine ecosystem processes and functions to enable better identification of management issues and response options.

* Gather and make available information needed by Reserve managers and coastal decision makers for improved understanding and management of estuarine ecosystems.

* To better our understanding of ecological values and processes of estuaries nationwide, by comparing the Delaware Estuary to other estuarine areas.

* Identify priority natural resources, gather baseline information on them, and establish indicators of change.

* Identify priority habitat management needs, gather information about how to best meet the needs, and provide technical guidance to implement the desired actions.

* Monitor the impacts of human stresses on the estuarine environment and the effectiveness of pollution control strategies.

* To better our understanding of human exploitation of the estuarine environment through time.

* Identify critical habitat requirements of living natural resources.

* Evaluate land use practices and management strategies in terms of their impacts and effectiveness.

* Publication of research results.

Specific objectives to aid in achieving these goals include:

* Collecting and building baseline databases for use in long-term and interdisciplinary studies, and for monitoring differences over time and for making comparisons with other areas.

* Develop an on-site library of research and reference materials for use by staff and other approved users.

* Become a repository for data collected on-site and at other National Estuarine Research Reserves.

* Promoting the Reserve's components in the research community as long-term field laboratories to be used by State or Federal agencies, academic institutions, and local or private environmental organizations.

* To involve the public by using volunteers to achieve research and monitoring goals.

* To encourage staff contributions in technical conferences and workshops.

* Developing laboratory facilities, field monitoring stations, and scientific equipment and gear as necessary to support the research and monitoring efforts.

* Seeking agreements with other research organizations or

institutions to facilitate and augment research and monitoring projects.

B. RESEARCH TOPICS AND PRIORITIES

1. NERRS National Research Priorities

Research programs in the Delaware NERR address coastal management issues identified as having a local, regional or national significance. Projects which benefit reserves in other states and those which correspond with the NERRS National Research Priorities are encouraged. National Research Priorities are:

* Water Management. Research is needed to increase understanding of how freshwater inflows affect estuarine productivity, govern the salinity regime, provide nutrients, couple primary and secondary productivity, and sustain habitats.

* Sediment Management. Rational biological criteria which can be used to evaluate sediment management strategies must be developed. Research should examine sedimentation processes and the relationships between sedimentation and ecological processes.

* Nutrients and Other Chemical Inputs. Research is needed to increase understanding of the relationships among nutrient inputs, nutrient cycling, and production. The environmental fate of chemical inputs, including toxicants, and the effects of these chemicals on the ecosystem are other important areas of study.

* Coupling of Primary and Secondary Productivity. Research should increase understanding of ecological relationships such as trophic structures and food web interactions and increase understanding of disruptions to these estuarine ecosystem processes.

* Estuarine Fishery Habitat Requirements. To formulate effective management programs, the relationship between estuarine fish production and the quantity and quality of nursery areas must be investigated. Information must be gathered on habitat selection, species migration, species residence time, food quantity and quality, and the effects of environmental variations on survival and growth of fish and shellfish.

Additional information on these subject areas can be found in the NERRS Research Plan (available from NOAA/SRD).

In addition to these five major research areas, NOAA recognizes the need for baseline information and lists the following research areas as being appropriate for Federal funding. (Note that the two priority areas are also priorities

under NOAA's phased monitoring program). The rationale for these research priorities is described in NOAA's National Estuarine Reserve Research System Research Plan (1987). Each year NOAA issues a NERRS Research Opportunity Announcement in which it elaborates on the latest interpretation of these priorities. Proposal funding decisions are based on the relationship between the proposed research and these national priorities.

a. Initial Baseline Surveys

Baseline surveys will be conducted to fill information gaps and to provide more thorough characterizations of the components. Water quality parameters of interest include salinity, turbidity, temperature, dissolved oxygen, pH, and nutrient concentrations. Environmental and ecological baseline data might be collected for sediment composition, productivity of submerged aquatic and emergent vegetation, hydrological characteristics, weather conditions, organic fluxes, and species composition of plant and animal communities. Baseline surveys can be used to:

* Yield data necessary to define or confirm estuarine management issues of concern.

* Serve as a reference for detection of environmental/ ecological change in the estuary.

* Aid in planning and conducting special studies related to the estuarine ecosystem.

b. Environmental Monitoring

Environmental monitoring will entail the systematic, periodic collection of selected data using many of the same parameters and the same sampling techniques and locations as the initial baseline surveys. These data may be collected by DNERR staff or volunteers, by other government agencies, or by outside researchers as part of their research projects. Impacts of new technology, products, and management strategies may be observed. A policy for quick response to collect data in the event of unusual conditions such as floods or spills will be established where feasible. U.S. Environmental Protection Agency-approved methods for sampling and sample handling will be adhered to in all water chemistry monitoring.

Environmental monitoring is designed to:

* Detect trends in estuarine resources or ecosystems.

* Provide information to aid in the management of the DNERR and in coastal zone management in general.

* Provide a data base for special studies.

2. Special Studies

a. Habitat Manipulations

Special environmental studies may include experimental research relating to natural resources, cultural resources, or socio-economic topics. Special studies will be approved and may be supported based on the research priorities of the NERRS Research Plan, the NERRS Monitoring Program, and site-specific management needs. Special studies may identify and examine relationships between human stresses and ecological effects; these studies may include historical and archaeological perspectives on these issues. Studies may include manipulative experiments appropriate to better management of estuarine systems.

Major habitat manipulations for experimental purposes will not be permitted in 75% of the core areas of the Delaware NERR. Up to 25% of the core areas may be subject to substantial habitat manipulations for experimental purposes, but the environmental effects of such approved manipulations should be temporary or reversible and not substantially affect adjacent core areas. What activities constitute "substantial" habitat manipulations, and what manipulations may be considered to be "temporary" or "reversible," will have to be evaluated on a case-by-case basis as they are proposed, done in consideration of ecological impacts and responses and of the long-term utility of the DNERR's lands for the goals and objectives of the proposed DNERR. Designated core areas where major habitat manipulations may occur will be contained within confined sub-watersheds of the Delaware Reserve's core, not spread over the Reserve's core areas in patchy or mosaic fashion. Experimental habitat manipulation in the designated core areas requires prior approval by the State, NOAA and, where applicable, by the Reserve property owners. Of course, any habitat manipulations requiring Federal or State environmental permits must be granted such prior to implementing the perturbations. Major or long-term habitat manipulations for experimental purposes will not be as restrictive in the Reserve's buffer zones in terms of areal limitations or duration of effects, but such buffer zone manipulations will also require prior approval by the State, NOAA and, where applicable, by the Reserve property owners.

Habitat manipulations necessary to protect or maintain the ecological character and purpose or utility of the Delaware Reserve, whether done in core or buffer areas to avoid or counteract unacceptable anthropogenic impacts or natural changes, may be undertaken. Habitat manipulations done for management purposes necessary to protect or maintain the ecological character and purpose of the DNERR may be substantial in nature if warranted, and may or may not be temporary or reversible (see Resource Protection Plan). Similar to habitat manipulations for research purposes, habitat manipulations necessary to avoid or offset undesirable environmental changes must have prior approval from the State, NOAA and, where applicable, from Reserve property owners.

b. Cultural Resources

Cultural resources research within the proposed DNERR may include prehistoric and historic archaeological excavations, historical research, and folklore and oral history studies. Studies conducted under the auspices of the DNERR program should focus on the relationship between the estuarine environment and the human groups which have exploited and changed it through time. Providing information to meet education goals will be a priority.

3. DNERR Research Priorities

DNERR research priorities will be developed by a DNERR Scientific/Technical Advisory Committee, done in coordination with other DNERR advisory committees. These priorities may be modified based on Reserve and site-specific management needs gained from initial baseline surveys and environmental monitoring. The DNERR research priorities will reflect both NERRS National Research Priorities and more specialized regional or local needs.

Examples of more generalized research topics for initial consideration are listed below:

* Sediment/water column nutrient fluxes
* Effectiveness of agriculture BMP's
* Analysis of living resource data sets
* Stock assessments of exploitable species
* Sublethal responses to toxins
* Hydrographic studies of circulation and mixing processes
* Trophic level interactions
* Ground-water flow and contamination
* Impacts of specific land use practices on aquatic, wetland and riparian habitats
* Remote sensing and delineation of wetland types and boundaries
* Plankton community composition and dynamics
* Benthic community composition and dynamics
* Non-point source pollution impacts
* Habitat restoration techniques
* Impacts of human population growth
* Environmental history of both components
* Natural community classification
* Plant community composition and dynamics

The DNERR will identify and promote specific study Research Reserve topics of particular interest to coastal resource managers in Delaware or the middle Atlantic region. Given the environmental setting of the DNERR and Delaware's coastal resource issues and needs, the following three areas of research might be emphasized by the DNERR:

* Development and refinement of environmental management techniques necessary to restore, maintain or enhance high

quality estuarine habitats and their living resources;

* Development and assessment of management techniques necessary to limit non-point-source aquatic pollutants;

* Adaptive and non-adaptive responses of biotic populations and communities to natural and human-created environmental stressors.

Examples of special studies topics encompassed by the three focus areas suggested above include:

* Seaward wetlands loss and landward wetlands formation relative to sea level rise; impacts of sea level rise on primary production of wetlands emergent vegetation.

* Status and dynamics of the oyster bar communities in Delaware Bay and its tributary tidal rivers.

* Effectiveness of various agricultural BMP's in reducing run-off of fertilizers, animal wastes, sediments, and pesticides into estuarine waters.

* Effectiveness of various urban stormwater BMP's in reducing run-off of sediments, hydrocarbons, heavy metals, dissolved nutrients, and pesticides into estuarine waters, with emphasis on the upper St. Jones River watershed.

* Population dynamics and stock assessments within the Delaware Estuary of important estuarine aquatic species: weakfish, summer flounder, bluefish, striped bass, white perch, American shad, anadromous herrings, blue crab, American oyster.

* Vegetation composition and waterbird use of managed impounded marshes, with emphasis on the lower St. Jones River watershed.

* Temporal and spatial variability in the use of tidal creek/marsh habitats as nursery areas for finfish and crabs; effects of managed impounded marshes on fish nursery habitats, with emphasis on the lower St. Jones River watershed.

* Biology, ecology and control of Phragmites grass, with emphasis on the lower Blackbird Creek watershed.

* Ecologically-sound saltmarsh mosquito control techniques, examining both the abatement efficacy and non-target effects of insecticides (both chemical and bacterial), source reduction (e.g. Open Marsh Water Management), and other control methods (e.g. introduced pathogens).

* Biology and control options for tabanid biting flies and ceratopogonid gnats.

* Creation or restoration of tidal ponds in dewatered marshes to enhance waterbird and aquatic habitats.

* Population dynamics and occurrences of horseshoe crabs, and their trophic linkage and importance for migratory shorebirds, with emphasis on the Delaware Bay shoreline adjacent to the mouth of the St. Jones River.

* Population dynamics and habitat utilization of waterbirds (waterfowl, wading birds, shorebirds).

* Ecological structure and function of tidal freshwater wetlands, with emphasis on Upper Blackbird Creek.

* Population dynamics and foraging ecology of muskrats.

* Population dynamics and foraging impacts of snow geese.

* Development of sampling and monitoring techniques to better assess water quality parameters.

* Hydrology (surface and ground-water) and ecology of the Delmarva Bays (swale freshwater-nontidal wetlands) in the upper watershed of Blackbird Creek.

* Causes and significance of shellfish bacterial contamination and finfish PCB accumulation.

* Development of better environmental indicators associated with archaeological research.

* Develop a better understanding of adaptation to the estuarine environment by prehistoric and early historic human populations.

* Water column ecological processes in the open waters of Delaware Bay (e.g. plankton community composition and dynamics, inorganic nutrient cycling, turbidity impacts, meso- and micro-circulation effects).

* Causes and significance of late summer fishkill events in tidal rivers and creeks; hypoxia/anoxia problems.

* Impacts of borrow pit operations (sand and gravel mining) on estuarine wetlands and waters, with emphasis on the middle section of the St. Jones River corridor.

* Impacts of bridge and highway construction on tidal freshwater and brackish wetlands, with emphasis on upper Blackbird Creek.

* Impacts of vertical and lateral leaching of pollutants from abandoned landfills, with emphasis on the middle section of the St. Jones River corridor.

* Eutrophication problems and corrective actions in

headwater millponds, with emphasis on the upper St. Jones River watershed.

* Management and recovery of rare species.

It is anticipated that the DNERR Research Program will be of most help in addressing coastal issues which need more technical information that is best obtained via scientific methodology (e.g. controlled testing of alternative hypotheses); or via descriptive survey, particularly if the issues require inventory of biotic populations or assessments of ecological systems or environmental processes.

C. DNERR POLICIES AND PROCEDURES FOR RESEARCH

Research at the DNERR will investigate the natural processes of the estuarine system and human impacts on these processes. One of the highest priorities is to coordinate, facilitate and conduct research to provide useful information for coastal management decision-making.

The proposed DNERR program makes both components available to researchers as long-term field laboratories which are especially suitable for studying estuarine problems.

The DNERR program offers:

* Long-term opportunity for temporal and spatial sampling in wetland, upland, and open water estuarine habitats.

* Greater opportunity for use of observational and analytical techniques in protected or controlled estuarine subsystems.

* The chance for long-term accumulation of comparative data at the Reserve components.

Through State ownership or long-term agreements with each component's property owners, the State has the opportunity to encourage and support certain research projects in these estuarine systems.

As previously discussed in Section XI.B.2., carefully-controlled habitat manipulations may be approved for research purposes in up to 25% of the DNERR designated core areas. Many important research questions in coastal resource management, particularly in regard to tidal wetlands, can only be satisfactorily examined via experimental manipulations of habitat.

It is often critical that field research necessitating habitat manipulation, in order to be successful, be given the same type of location, support, access and security as non-manipulative field studies. Thus, in order to accommodate the broadest range of research needs in meaningful fashion, the proposed DNERR will <u>not</u> require that all manipulative studies be

limited to buffer area sites or to locations off the Reserve.

However, for the purposes of serving as scientific controls, it is desirable to designate significant portions of the Reserve as areas where human influences will be kept at a minimum. Thus, at least 75% of the DNERR core areas will be excluded from consideration for research involving substantial habitat manipulations. Up to 25% of the core area may be set aside where research activities of any kind will be kept at a minimum (see Resource Protection Plan), helping to insure the maintenance of experimental control zones. When substantial habitat manipulations for research purposes are permitted within up to the designated 25% of the proposed DNERR core area, the manipulative effects should be temporary or reversible in nature and not have significant impacts on any adjacent core area off-limits to experimental manipulation.

As previously stated, what activities constitute "substantial" habitat manipulations, and what manipulations may be considered to be "temporary" or "reversible", will have to be decided on a case-by-case basis as they are proposed, done in consideration of ecological impacts and responses and of the long-term utility of the DNERR's lands for DNERR goals and objectives. Research involving substantial manipulation of habitat, whether done in core areas or buffer areas, will require prior approval by the State, NOAA and, where applicable, by the Reserve property owners.

To assist new researchers at the Reserve, information packets will be available from the Reserve research coordinator. These packets will contain background information pertaining to each component and an area map, designating the reserve boundaries. New researchers will also be given a "tour" of the reserve area to gain familiarity with the research surroundings and general location.

Research, monitoring and education projects will receive high priority within the reserve boundaries. Traditional uses of public areas will continue as regulated under federal, state, or local authority. Reserve managers are responsible for carefully balancing uses of the reserve to ensure that the objectives of the reserve program are protected and sustained.

Research opportunities are available to any qualified scientist, faculty member, undergraduate, or graduate student affiliated with any college, university or school; non-profit, non-academic research institution (e.g. research laboratory, independent museum, professional society); private profit organization; or state, local or federal government agency. These opportunities are also available to any individual who has the resources and capabilities needed to perform the work required.

Research opportunities will be available to all applicants without regard to manner of funding. Financial support may be available for research if the results are directly applicable to

improved coastal zone management. Support may come through Delaware's Department of Natural Resources and Environmental Control, the NOAA Office of Ocean and Coastal Resource Management, NOAA Sea Grant, the National Park Service Historic Preservation Fund, the Environmental Protection Agency, and other sources. Researchers not seeking financial support may apply to do research at any time. Researchers seeking financial support from NOAA must follow NOAA's research and monitoring time table.

All research proposals are evaluated by the reserve manager and the research coordinator for consistency with DNERR goals and to ensure that the proposed research will not unduly interfere with other research or activities at the reserve. A DNERR Scientific/Technical Advisory Committee (STAC) will be formed to provide advisory input to the reserve manager and research coordinator concerning the importance, suitability, and practicality of all research proposals proposed for the DNERR. The STAC will consist of personnel from the DNERR, other State agencies and programs, Federal agencies, and academic research institutions. Projects will be selected based on their importance to coastal zone management issues, scientific/educational merit, and technical approach. Other project selection criteria include: the environmental consequences of the project; immediacy of need; and the proposed project's relationship to other available information and studies. Under the Delaware Antiquities Act, archaeological research on the Reserve must also be approved by the Director of the Division of Historical and Cultural Affairs.

1. Procedures for NOAA-Funded DNERR Research

Proposals which target NOAA funding will also be evaluated by NOAA using established guidelines. These guidelines are outlined in the NERRS' document for "National Research Priorities and Proposal Guidelines", which include guidance for proposal preparation and submission, plus details of proposal review and evaluation, which identifies a peer review process. Proposals for NOAA-funded research to be done in association with the DNERR will also be evaluated by the DNERR Scientific/ Technical Advisory Committee for advisory comments about a proposal's importance, suitability, and practicality. In order to qualify for NOAA funding, DNERR research proposals must address one or more of the NERRS National Research Priorities and fulfill the requirement of the appropriate Request for Proposal. NOAA funds are awarded on a competitive basis and proposals will be competing with other research proposals in reserves throughout the National Estuarine Reserve Research System.

The DNERR research coordinator is responsible for coordinating all research and monitoring activities for the Reserve. To facilitate this, NOAA will maintain close contact with the DNERR research coordinator and will keep him or her informed of the progress of NOAA-funded researchers. NOAA will send copies of any required progress reports, the final report, and any other research information which they receive to the

DNERR in a timely manner. The DNERR will keep two copies of the final report at the DNERR central repository and the research coordinator will keep the third copy. The DNERR research coordinator will maintain regular communication with the NOAA-funded researchers themselves. He or she will aid in coordinating research activities in the reserve and, when possible, will aid in fulfilling the needs of the researchers.

To achieve the NERRS goals of 1) "making available information necessary for improved understanding and management of estuarine areas" and 2) "enhancing public awareness and understanding of the estuarine environment", NOAA-funded researchers may be requested to provide a presentation on their research findings at the Reserve facility, the DNREC Building in Dover, or other appropriate location.

2. Procedures for State-funded DNERR Research

All proposals which do not target NOAA funding will be evaluated by the Scientific/Technical Advisory Committee. Specific procedures will be developed, and it is envisioned that desirable features of the review process already existing for NOAA funding will be incorporated into the STAC's procedures for evaluating proposals that might be funded by State money or other non-NOAA funds. The DNERR Scientific/Technical Advisory Committee will help determine appropriate research topics and protocols. Committee members will lend expertise to specific projects and advise research programs on such matters as quality assurance. Research proposals that focus primarily on site-specific topics and do not rely on NOAA funding do not need to be approved by NOAA as long as they are consistent with identified DNERR research needs, but a courtesy copy of these proposals will also be sent to NOAA. Coordinated and streamlined procedures for the review and approval of research proposals and permits will be established.

The DNERR requires that researchers provide the research coordinator with timely progress reports, three copies of the final report, and an abstract and one copy of any journal publications resulting from any state-funded research at the Reserve. The final report will include: an abstract; a literature review; methods; analyses; results; and a conclusion. It will include a summary of the gathered data and a list of the analyses completed. The DNERR will keep two copies of the final report at the DNERR central repository and the research coordinator will keep the third copy. In addition to a final report, the researcher will keep the research coordinator updated on the progress of the project by means of timely written progress reports. Records, data, reports, publications, and other relevant materials will be kept at the DNERR central repository. Research information will also be forwarded to NOAA, which will act as a central clearinghouse and the center of the information network of the NERR System.

After completion of the final report, a presentation may be developed by the researcher at request of the research

coordinator to provide information on the project findings. This presentation will be given at the DNERR facility or other appropriate location at a time negotiated by the research coordinator and the researcher. These presentations will help to achieve the goal of the Reserve to provide information necessary for improved understanding and management of estuarine systems to coastal decision makers and the public.

3. Procedures for DNERR Research (funded by sources other than NOAA or the State)

The DNERR research coordinator will negotiate reporting and presentation requirements for research funded by sources other than NOAA or the State of Delaware with the reserve manager, the researcher and the funding source. For example, researchers who must provide progress reports to their funding agency may be asked to submit copies of those reports to the DNERR research coordinator. Similar to NOAA or State-funded research proposals, advisory input about the importance, suitability, and practicality of a research proposal for the DNERR will be solicited from the DNERR Scientific/Technical Advisory Committee.

D. MONITORING PROGRAM

1. NOAA Phased-Monitoring Program

In 1989, NOAA initiated a phased-monitoring program to assist reserves in developing a better understanding of its estuarine resources.

- Phase I, Environmental Characterization, which involves literature review and/or field research to acquire all available information on hydrology, geology, water chemistry, water quality, biological resources, cultural resources, and the problems and issues confronting the reserve environment.

- Phase II, Site Profile, which involves a synthesis of information gathered in Phase I to provide an overall picture of the Reserve in terms of its resources, issues, management constraints, and research needs;

- Phase III, Procedures and Requirements, which involves identifying parameters to be measured, procedures to be used (criteria for measurements, quality control, and standard procedures where they already exist), sampling strategy for selected parameters (spatial and temporal intervals), storage and retrieval of data (reporting, formatting and analytical requirements), manpower requirements, logistics, and cost; and

- Phase IV, Implementation, which involves, first, pilot projects and upon successful evaluation, full-scale monitoring of selected parameters.

The DNERR phased-monitoring program will be integrated where appropriate and beneficial with other environmental monitoring programs conducted by the State, federal agencies, and private organizations. The DNERR phased-monitoring program will follow NOAA guidelines for its development and implementation.

The reserve research coordinator will work to incorporate the following into all monitoring programs:

- hypothesis testing
- relationship to management issues
- quality assurance/quality control
- means of determining program effectiveness
- periodic review
- data management and analysis
- publication of data

2. Recruitment for DNERR Research Programs

Recruitment of researchers is important to building the DNERR data base and to establishing the components as long-term natural field laboratories. Recruitment of researchers with an established interest and capability will be one of the functions of the research coordinator. Recruitment strategies include:

* Coordination through scientific/technical advisory committees.

* Participation of DNERR staff in research symposia, conferences and workshops.

* Intern programs for graduate students or upper-class college students, funded by Federal, State or other sources.

* Annual announcements of research opportunities and NOAA research funds through NOAA's Sanctuaries and Reserve Division.

* Other research and monitoring funding.

3. Off-Reserve Research Projects

While it is expected that much of the DNERR research will occur on the Reserve's two components, it is also anticipated that substantial research efforts associated with the DNERR will occur outside the Reserve's boundaries. It is probable that many of the off-reserve studies will occur in close proximity to the components (e.g. in the nearby open waters of Delaware Bay, in the State Wildlife Areas along the lower St. Jones River, in the urbanized upper watershed of the St. Jones River, in the phragmites-dominated tidal wetlands of lower Blackbird Creek, in the Delmarva Bay freshwater wetlands in the upper watershed of Blackbird Creek). However, research studies supported or

assisted by the DNERR may also occur somewhat distant from the components. In particular, research associated with the environmental problems of Delaware's Inland Bays (i.e. Rehoboth, Indian River, and Little Assawoman Bays) would be encouraged under DNERR auspices. While the extensive Delaware Bay system is an excellent representative of a drowned river, coastal plain estuary along the mid-Atlantic Coast, having expansive fringing wetlands and subestuaries, it is not characteristic of lagoon or bar-built estuaries which are also common in the middle Atlantic region. Delaware's Inland Bays are representative of lagoon or bar-built estuaries, and research attention paid to these systems would give the DNERR an active role in examining all of the middle Atlantic region's major estuarine habitat types. The environmentally stressed nature of Delaware's Inland Bays could be compared to similar but less degraded lagoon-type estuaries further south, from Chincoteague Bay southward behind the chain of the Eastern Shore barrier islands of Virginia. Additionally, it is anticipated that cooperative wetlands studies with the University of Delaware's College of Marine Studies would involve DNERR efforts in the Great Marsh near Lewes.

4. Coordination of Research Efforts

A major research benefit offered by the Reserve is the potential for coordination of research efforts. The Reserve offers permanent places where various research institutions can coordinate their projects and compare results to complement one another's work. Data will be compiled, assembled, and analyzed, and will be made available in the appropriate form, for use by other researchers, coastal managers and the public. Research coordination reduces unnecessary duplication and effectively decreases the cost of publicly-supported research.

a. Coordination Between DNERR Components

The research coordinator will coordinate the research between the two DNERR components, done with assistance from the advisory committees and NOAA.

b. Coordination with the NERR System

The DNERR works closely with NOAA staff, especially their research coordinator, to develop and assess National Research Priorities. NOAA is also involved with the Reserve through research funding and proposal evaluation. The research coordinator will communicate with other estuarine research coordinators in other states, particularly mid-Atlantic states, and will work with NOAA and other research coordinators to establish a national information exchange network.

Data from the DNERR contributes to the national network long-term study to monitor the status and trends of estuarine ecosystems. Data from the National Estuarine Research Reserve System make a substantial contribution to the understanding of long-term ecological effects on estuaries and are useful in

predictive trend analysis of ecological stresses. The coordinated research network aids greatly in understanding the theoretical and practical aspects of conservation and coastal resources management.

c. Coordination With Other Coastal/Estuarine Research Programs

(Federal and State agencies, academic institutions, and private organizations)

Reserve staff will also assist in the coordination at the State level of NOAA's federal coastal and estuarine research programs, such as the Coastal Oceans Office; the Status and Trends Program; the Coastal Zone Management Program; and the National Sea Grant Program. How this coordination will occur will depend upon future desires and guidance from NOAA. Research coordination with non-NOAA agencies, whether they be Federal or State, would not be done to purposely influence their research agendas, but rather to make sure that research is not being unnecessarily replicated by the DNERR, and to see if "anybody" is undertaking those research topics that are identified as high priority by the DNERR. It will be very important to coordinate DNERR research efforts with the U.S. Environmental Protection Agency's two National Estuary Programs in Delaware (the Delaware Estuary Program and the Inland Bays Estuary Program), for both development and implementation of each programs' Comprehensive Conservation and Management Plans. Other federal agencies for which coordination of DNERR research is highly desirable include the U.S. Fish and Wildlife Service's new environmental outreach program, located at Bombay Hook National Wildlife Refuge, plus the Service's efforts to implement the North American Waterfowl Management Plan, achieved in part via the Private Lands Initiative; the U.S. Soil Conservation Service's office in Dover, particularly for studies of non-point source pollution control methods; and the U.S. Geological Survey's office in Dover, particularly for hydrological studies of surface and ground waters. Coordination of research interests might also be appropriate for some fisheries topics between DNERR and the Mid-Atlantic Fishery Management Council (headquartered in Dover) for offshore federal waters, and also with the Atlantic State Marine Fisheries Commission for inshore state waters.

Similar to interactions with federal agencies, it will also be critical to coordinate research interests and efforts between State agencies. Within the Delaware DNREC, all five Divisions have various interests in applied estuarine research: the Divisions of Fish and Wildlife; Soil and Water Conservation; Parks and Recreation; Water Resources; and Air and Waste Management. In particular, coordination of research between the DNERR and the Delaware Coastal Management Program should be emphasized, and activities within the DNERR should be consistent with the DCMP. Coordination of research will also involve other

State agencies: the Department of Agriculture's Forestry Section; the Division of Historical and Cultural Affairs' Bureau of Archaeology and Historic Preservation; and the Division of Highways. The Delaware River Basin Commission, a quad-state independent agency (DE, NJ, PA, NY), also sponsors applied research in the Delaware Estuary; coordination between the DNERR and the DRBC should yield mutual benefits.

Of primary importance for research coordination is interaction between the DNERR and nearby academic research institutions. In particular, research efforts should be coordinated between the DNERR and the University of Delaware's College of Marine Studies, for both its Lewes and Newark faculties, facilities and projects, with special attention to interactions with the Delaware Sea Grant College Program. Other research coordination of special interest between the DNERR and the University would involve the College of Agriculture (Departments of Entomology and Applied Ecology; Agricultural Engineering; and Plant and Soil Sciences), the School of Life and Health Sciences, the College of Arts and Sciences (Dept. of Anthropology Center for Archaeological research), and the College of Urban Affairs (Center for Historic Architecture and Engineering). Research coordination between the DNERR and Delaware State College in Dover would focus on the College's Department of Agriculture and Natural Resources and the Department of Biology. Research coordination with the Cooperative Extension Services at both the University of Delaware and Delaware State College for agricultural topics would be beneficial. Interactions with Wesley College in Dover would be through their undergraduate Environmental Sciences Program. On the New Jersey side of Delaware Bay, Rutgers University operates its Shellfish Research Laboratory in Bivalve, making for probable mutual interests between the DNERR and Rutgers University.

The last area necessitating DNERR research coordination is with private environmental organizations who either perform independent or cooperative environmental research. Some of these organizations may also be able to provide volunteers to the DNERR to help with research projects or environmental monitoring. Examples of private organizations who perform various kinds and levels of environmental research include the Delaware Nature Society (e.g. the Stream Watch Program); the Nature Conservancy, particularly for plant and animal inventories; Ducks Unlimited, supporting studies of waterfowl populations and their habitats; the National Audubon Society and its local chapters, plus the Delmarva Ornithological Society, for avian population assessments; the member organizations of the Western Hemisphere Migratory Shorebird Reserve Network; marine conservation organizations such as the Atlantic Coast Conservation Association and the American Littoral Society; the Archaeological Society of Delaware; and the Friends of John Dickinson Mansion. These are but a few examples of private environmental organizations where coordination of applied research with the DNERR may be mutually beneficial.

Finally, the DNERR Scientific/Technical Advisory Committee members should promote the DNERR components as research facilities, and act as liaisons between the Reserve and agencies in coordinating research and monitoring efforts.

5. Information Dissemination

Information gathered in DNERR research and monitoring and the management implications of this information will be made available to decision makers and the public in understandable forms.

Both NOAA and the DNERR will encourage the dissemination of research results. Methods include:

- Journal articles in the peer-reviewed literature;
- Presentations at professional societies; and
- Special symposia arranged by NOAA or reserves, often in association with other meetings such as the biennial meetings of the Estuarine Research Federation or Coastal Zone Managers.

In addition to NOAA information dissemination routes, the DNERR will utilize several other avenues of information exchange including:

- Summary of research at Reserve;
- Workshops, conferences and teach-ins at Reserve;
- DNERR brochure, distributed with the annual call for proposals at appropriate conferences and other events;
- Press releases to local media;
- Articles in journals of local organizations;
- Direct mailings to State and local decision makers;
- Regular contact with representatives of other State and Federal agencies, local government agencies, and planning boards.

XII. RESOURCE PROTECTION AND RESTORATION PLAN

Along with research and education, resource protection is a major component of the proposed DNERR. Estuaries are among the most biologically productive systems on Earth. As such the productivity and integrity of the Research Reserve's resources must be protected and, where necessary, restored in order to provide a stable environment for research and education programs which are used to address coastal management issues.

A. GOALS

The goals of the Research Reserve's resource protection and restoration plan will be to:

* Maintain the Reserve's estuarine ecosystems for continuous future use as natural field laboratories where information essential to coastal management decisions can be gathered and disseminated.

* Ensure a stable environment for research through long-term protection of the Reserve, including open water, transitional area wetlands, and adjacent uplands.

* Protect significant natural estuarine sites for education and interpretation programs.

* Protect the habitats of fauna and flora as an integral part of the natural system.

* Permit restoration of degraded areas to a former, more natural condition when appropriate and practicable, and when the restoration will enhance the research or education value of the reserve.

* Protect the Reserve from unduly disruptive activities occurring inside and outside of its boundaries.

* Protect cultural resources which contribute to an understanding of human interactions with the estuarine system.

Specific objectives to aid in achieving these goals include:

* Acquiring and protecting key land and water areas identified in the site selection process.

* Controlling access to the Reserve to minimize adverse impacts on critical natural and cultural resources.

* Aiding in enforcement of permitted uses of the site.

* Being knowledgeable of and involved with land use issues in the vicinities of the Reserve that could impact it.

* Coordinating with neighboring property owners and local, state, and federal agencies in order to maintain a proper buffer to the Reserve's core areas.

* Coordinating research and education programs to minimize adverse impacts on critical natural and cultural resources.

* Providing for adequate public participation and use of the Reserve to inform and educate them as to the need to protect sensitive resources.

* Providing an undisturbed estuarine site for long-term baseline resource data needs.

B. POLICIES AND PROCEDURES

1. General Policies

Resource protection relies on the coordinated efforts of the research and education programs and Management Plan policies. It also relies on a number of existing federal, State and local laws and regulations, plus Reserve and property owner policies, enforced by Reserve staff and property owners. It is also the responsibility of Reserve staff to be knowledgeable of and involved with land use issues in the vicinity of the components that could impact the Reserve.

NERRS regulations allow for multiple uses of reserves to the degree compatible with each reserve's management plan and consistent with the mission and goals of the NERRS. The DNERR Management Plan focuses on maintaining areas as field laboratories and on developing a coordinated program of research and education.

Public access is encouraged on those parts of the Reserve that are publicly owned or that have received private landowner permission, as long as it is not to the detriment of the resource or does not interfere with approved research. Public access may be restricted in key resource protection areas. These areas will be identified in a management plan and adequately posted at the site. Future research directed at identifying resources of concern (i.e. federal or state rare species, significant natural communities, critical cultural resources) will help delineate these protection areas as well as direct research, education programs and overall Reserve management. The Reserve manager will develop access policies and coordinate enforcement of regulations that will help maintain natural conditions and preserve cultural resources.

Traditional use activities (hunting, fishing, trapping) in the proposed DNERR may continue up to levels currently permitted under local and State laws, or under regulations in place with property owners, as long as these uses do not unduly conflict with research or educational concerns and the harvests conform to

legal practices and limits. Potential conflicts can best be avoided by coordination and reasonable compromise. Care should be given to managing the impacts of traditional use activities occurring in rare species habitats or in unique biotic communities. These activities are permitted only in designated areas.

All projects carried out in the Reserve for which standardized, authorized Best Management Practices have been developed will follow such BMP's to avoid degradation of the natural environment and of cultural resources. Any activity on State-owned land or private land done under cooperative agreements will adhere to a conservation plan acceptable to all cooperators. Such plans will be formulated for core and/or buffer areas. Resource protection will typically be addressed by restricting certain land use activities. Erosion and sediment control and stormwater management plans will be carried out to enhance water quality and quantity by limiting sediment, toxics, chemicals, and waste oil runoff. The use of insecticides, herbicides, and other toxic substances when necessary will be carefully planned and their application will follow all required or appropriate procedures. Pesticides with rapid breakdown and negligible effects on the environment could be used when necessary with prior coordination with or approval of the Reserve manager.

DNERR staff will encourage any activities outside of and adjacent to the Reserve to be compatible with resource protection and conservation. Activities such as development, infrastructure concerns and any land disturbing action that occurs upstream from the Reserve or any of its tributaries will be monitored.

The planning of any construction or substantial site manipulation will include a heritage inventory survey for rare species and significant natural communities and a cultural resources survey. If critical resources are identified this information will be noted in the appropriate databases and plans may be altered as necessary to minimize adverse impacts.

Research proposals and education programs will undergo a review by appropriate agency, Advisory Committee or Reserve staff for their impacts on resource protection. The type and scope of project will be weighed against the need to maintain critical natural and cultural resources.

Research is a key use of the Reserve and is given a high priority in the management plan. Interference with research activities can disrupt the ability to achieve effective long-term management of the estuarine systems. Reserve staff will monitor research sites and will post signs identifying these sites. With the exception of samples taken for approved research and education programs, and fish and game taken from designated fishing, hunting, or trapping areas, nothing may be removed from the core areas without prior approval of the Reserve manager. Plants, animals, minerals, cultural resources, or any parts of

these must remain to protect the integrity of these key areas. Objects and samples may be removed from buffer zones for Reserve research or education programs as necessary.

Because the DNERR falls under a number of different and sometimes overlapping jurisdictions of local, State and federal agencies, coordination and cooperation among all authorities is essential. Some of the State and local regulations directly affecting the Reserve are described at the end of this section. The Reserve staff will coordinate activities with the appropriate regulatory agencies and other resource protection efforts. A clearinghouse will be created to help the Reserve coordinate with other agencies which propose projects potentially impacting the Reserve.

2. Restoration/Habitat Manipulation Policy

The restoration or manipulation of certain habitats within the Reserve is necessary and desirable at times. These activities can be permitted under carefully controlled conditions that consider resource protection concerns. The Management Plan is flexible to allow these types of activities, since they may be well suited for research and education opportunities or might be necessary to address environmental problems, as long as they are compatible with resource protection.

Most restoration or manipulation activities will be directed at restoring the natural plant and animal community of a site, or will be done in association with experimental research projects. In part, this would help increase habitat and species diversity and should prevent further degradation of the resource. Any species reintroductions will be native to the area. Restoration and habitat manipulation projects can provide a good baseline for long-term research and education needs. Restoration or habitat manipulation resulting in substantial action will require prior approval by the State, NOAA and where applicable, by the site property owner.

As discussed in the Environmental Research and Monitoring Section (XI.B.2. and XI.C.), substantial habitat manipulation activities for research will be allowed in the buffer areas and in up to 25% of the core areas. The remaining 75% of the Reserve's core areas will be left relatively undisturbed in order to serve as sites for control purposes or to do non-habitat-altering studies. Of this 75% of the core areas, 25% may be identified in advance as areas of minimum disturbance, essentially serving as long-term control sites. These minimum disturbance sites should be confined to well-defined sub-watersheds and not spread over the core areas in a patchy or mosaic fashion. These sites also should be representative of the range of habitat types within the core and should consider areas where resource protection is a major concern (e.g. rare species habitat or unique biotic assemblages). Of the remaining 75% of the DNERR core areas, up to 1/3 (or 25% of the total core areas) may be subject to habitat manipulation for approved research purposes.

In summary, substantial habitat manipulation for experimental purposes may occur in up to 25% of the DNERR core areas if the alterations are temporary or reversible in nature, are confined to well-defined sub-watersheds and not spread over the core areas in a random fashion, do not substantially affect adjacent core areas of undisturbed habitat, and do not degrade rare species habitat or unique biotic assemblages. As stated in the Environmental Research and Monitoring Plan, what activities constitute "substantial" habitat manipulations, and what activities may be considered to be "temporary" or "reversible", will have to be evaluated on a case-by-case basis as they are proposed, done in consideration of ecological impacts and the purposes of the Reserve.

The concern with habitat manipulations for research purposes, in terms of type, extent or duration of alterations, will not be as stringent in the DNERR buffer areas. However, degrading impacts on rare species habitats or unique biotic assemblages will not be permitted, and buffer area alterations should not substantially affect core areas where not intended or permitted.

Also discussed in the Environmental Research and Monitoring Plan was the need for restoration and habitat manipulation practices to protect or maintain the purposes and integrity of the Reserve. These activities, when necessary, may be undertaken in either the core or buffer areas to prevent or offset undesirable or unacceptable changes caused by human influences or nature (for example, mosquito-borne human diseases such as Eastern Equine Encephalitis). In some cases the responding activity may more involve the direct management of species populations rather than their habitats. Manipulation or alteration of habitat or species populations for management purposes should be accomplished with minimal impacts on non-target resources or functions of the Reserve. Examples of changes that may necessitate habitat or population management responses include excessive shoreline erosion or wetlands submergence caused by relative sea-level rise; excessive denuding of emergent vegetation by snow goose grazing; excessive expansion of phragmites cover; excessive production of pestiferous mosquitoes, especially for off-site nuisance relief and disease control; or excessive siltation caused by upland run-off or downstream transport. Where needed, environmentally-sound corrective or preventive measures for substantial environmental problems may be permitted in core or buffer areas. All such actions must have prior approval from the State and, where applicable, from site property owners.

Both of the DNERR components produce pestiferous mosquitoes that require control for their off-site nuisance problems and disease-vector potential. Both of these potential problems can directly affect the quality-of-life in an area greater than 20 miles distance from the Reserve. The Lower St. Jones River component is of more mosquito-production concern, since it is only six miles from downtown Dover, and its more saline habitats produce more saltmarsh mosquitoes than do the upper Blackbird

Creek marshes. Saltmarsh mosquitoes will routinely fly 10-15 miles inland from their marshes of origin and are capable of carrying problems as far as 40 miles away from their breeding grounds.

In order to satisfactorily contend with the mosquito problems, all ongoing mosquito control practices will continue in both core and buffer zones of both Reserve components. This primarily involves the DNREC's Mosquito Control Section's surveillance of mosquito production levels, and selective application (as needed) of insecticides. Similar to its insecticide control efforts throughout the State, the Section will use insecticides on the Reserve in an environmentally-compatible manner. Essentially, the need for insecticide use, types of insecticides, methods of application, areas of treatment, and frequency of treatments will be the responsibility and decision of the DNREC's Mosquito Control Section in consultation with the Reserve manager.

In addition to using insecticides for saltmarsh mosquito control, the Mosquito Control Section has an aggressive policy of trying to reduce statewide its insecticide use as much as possible, primarily by relying on source reduction methods such as Open Marsh Water Management (OMWM) wherever practical. The mosquito-breeding areas of the lower St. Jones River tidal wetlands are currently targeted for OMWM treatment, part of the 15,000 acres (out of Delaware's total 83,000 acres of tidal marshes) of severe saltmarsh mosquito-production habitat identified in the State. The OMWM treatment effects are primarily the permanent installation or restoration of selectively-located ponds and ditches; temporary deposition of a thin layer of excavated spoil; and a long-term, substantial reduction in the need for insecticide use. A major benefit of the OMWM method is the opportunity to restore more permanent water habitats to high marsh zones that have been dewatered, mainly in marshes where parallel-grid-ditching has been extensive (e.g. the lower St. Jones River marshes). The restoration or creation of tidal ponds that do not dry-out at low tide substantially enhances aquatic and waterbird habitats in tidal wetlands, in addition to significantly decreasing mosquito production.

OMWM planning and implementation in the lower St. Jones River marshes will include, in addition to the thorough review of the appropriate Reserve and NOAA staff prior to installation, permit and field reviews by the member agencies of the Delaware Mosquito Control Advisory Committee (i.e. the Army Corps of Engineers; U.S. Environmental Protection Agency; U.S. Fish and Wildlife Service; National Marine Fisheries Service; the DNREC's Sections of Mosquito Control, Wildlife, and Fisheries; and the DNREC's Wetlands and Aquatic Protection Branch). OMWM systems will be installed in the Lower St. Jones River DNERR component (in both core and buffer areas), using the OMWM guidelines that the Section follows statewide in its operations.

Most of the potential OMWM work in the lower St. Jones River

tidal wetlands is in salt hay patches or zones, located in narrow bands behind natural creekside levees or along the landward upper fringes of the marsh. The design and installation of OMWM systems for the Lower St. Jones River DNERR component will carefully consider and accommodate the Reserve's needs and functions for research, education and resource protection.

At this point in time, the Delaware Mosquito Control Section does not believe that OMWM is desirable or needed for the upper Blackbird Creek area, given the physical characteristics of the area and the amount and types of mosquitoes produced.

C. STATE AND LOCAL REGULATIONS AFFECTING THE DNERR

The following laws and regulations affect activities that may be carried out in and around the Reserve's watershed.

TIDAL WETLANDS

Tidal wetlands in Delaware are protected by the Wetlands Act (7 Del. C. Chapter 66). The Act covers all "wetlands" defined as:

"Those lands above the mean low water elevation including any bank, marsh, swamp, meadow, flat or other low land subject to tidal action in the State along the Delaware Bay and Delaware River, Indian River Bay, Rehoboth Bay, Little and Big Assawoman Bays, the coastal inland waterways, or along any inlet, estuary or tributary waterway or any portion thereof, including those areas which are now or in this century have been connected to tidal waters, whose surface is at or below an elevation of 2 feet above local mean high water, and upon which may grow or is capable of growing any but not necessarily all of the following plants: [list of plants] and those lands not currently used for agricultural purposes containing 400 acres or more of contiguous nontidal swamp, bog, muck or marsh exclusive of narrow stream valleys where fresh water stands most, if not all, of the time due to high water table, which contribute significantly to ground water recharge, and which would require intensive artificial drainage using equipment such as pumping stations, drain fields or ditches for the production of agricultural crops."

The Department of Natural Resources and Environmental Control surveys and delineates its tidal wetlands; regulatory maps provide jurisdictional boundaries. Under a concurrent review process with the Army Corps of Engineers, the State requires a permit for any dredging, filling, or other alterations or construction, bulkheading, construction of piers, jetties, breakwaters, boat ramps, or mining, drilling or excavation in State mapped wetlands.

No permit may be issued until the county or municipality having jurisdiction has first determined that the activity is lawful according to zoning procedures. Proposed activities are evaluated considering the factors of environmental impact, aesthetic effect, the number and type of supporting facilities

required and the environmental impact of such facilities, the effect on neighboring land uses, State, county and municipal comprehensive plans for the development and/or conservation of their areas of jurisdiction and economic effect.

Exemptions from permit requirements include mosquito control activities authorized by the Department, construction of directional aids to navigation, duck blinds, foot bridges, (which connect one upland area to another upland area), boundary stakes, wildlife nesting structures, grazing of domestic animals, haying, hunting, fishing and trapping.

Projects which would require wetland permits within both the lower St. Jones River and the upper Blackbird Creek components would include any impacts to tidal wetlands for the construction of piers, docks or boat ramps. Any placement of permanent structures, sampling devices or markers for research purposes would also require a wetlands permit.

SUBAQUEOUS LANDS

The purpose of the Subaqueous Lands Act, 7 Del. C., Chapter 72, is to protect against uses or changes which may impair the public interest in the use of navigable waters. "Subaqueous lands", including rivers, lakes, ponds, streams, embayments, lagoons and other navigable waterways, means "submerged lands and tidelands". By definition, the landward extent of jurisdiction in subaqueous lands is the mean high tide line, or the ordinary high water line in non-tidal waterbodies. The Act empowers the Secretary of the Department of Natural Resources and Environmental Control and the Governor, (for commercial projects), to regulate the use of both public and private subaqueous lands. Permits, leases or letters of approval issued by the Wetlands and Aquatic Protection Branch are required to deposit material upon, remove material from, construct, modify, repair or reconstruct or occupy any structure or facility upon subaqueous lands, as well as new and maintenance dredging projects.

Regulations governing the use of subaqueous lands stipulate that no activity may be undertaken which might contribute to the pollution of public waters, adversely impact or destroy aquatic habitats or infringe upon the rights of public or private owners. Examples of activities regulated under this statute which may be proposed for the St. Jones River and upper Blackbird Creek components would include the construction of piers, utility or road crossings, docks, boat ramps or mooring facilities.

PROPOSED FRESHWATER WETLANDS ACT

The Delaware Department of Natural Resources and Environmental Control has developed a Freshwater Wetlands Act (7 Del. C. Chapter 76) with the goal of no net loss of the state's remaining freshwater wetland base by acreage and function. "Freshwater wetlands" means open waters, aquatic flats and bars, or "those areas that are inundated or saturated by surface or

groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, excluding areas subject to jurisdiction pursuant to 7 Del. C. Chapter 72 (Subaqueous lands) and areas mapped as tidal wetlands pursuant to 7 Del. C. Chapter 66.

The Secretary of DNREC will seek to assume administrative authority of Section 404 of the Clean Water Act to the state. The Freshwater Wetlands Act is structured similarly to the Wetland Act of 1973 and is consistent both with this act and with Section 404.

If passed, this proposed legislation would regulate all activities not exempted by statute or regulations rather than only the placement of dredge or fill material currently regulated by the Corps of Engineers under Section 404. Possible impacts to freshwater wetlands within the lower St. Jones River and upper Blackbird Creek components which would require a permit or the application of best management practices, should this Act be passed, would include any applied or basic research activities which would have more than a de minimis impact.

ARCHAEOLOGICAL ACTIVITIES

Prehistoric and historic archaeological sites on state-owned or controlled properties in Delaware are protected by an antiquities act (Chapter 54, Title 7, Delaware Code). Under this act, only the governor or the director of the Division of Historical and Cultural Affairs may give permission to collect artifacts or to conduct archaeological surveys or excavations on state land. Any artifacts found on state land, regardless of where or by whom, are the property of the state, and are to be deposited with the Division of Historical and Cultural Affairs for curation and display. The unauthorized collection of artifacts or excavation of sites is punishable by a $100 fine and/or a 30-day prison term.

Unmarked human remains are further protected by an amendment to the antiquities act. The provisions of this act apply to burials on both public and private land. Human remains that are not the subject of an investigation by the Medical Examiner can only be excavated by professional archaeologists with the approval of the director of the Division of Historical and Cultural Affairs and a Committee on Unmarked Human Remains, if the remains are determined to be those of a Native American. If the remains are those of a member of any other ethnic group, an effort must be made to obtain permission from the next-of-kin. After excavation, the remains may be studied by a skeletal analyst for 90 days before they are reinterred. Unauthorized acquisition, excavation, or display of human remains is punishable by a fine of not less than $1000 or more than $10,000 and/or imprisonment of up to 2 years.

NATURAL AREAS PRESERVATION

The 1978 Natural Areas Preservation System Act (7 Del. C.

Chapter 73) established a means to set aside and protect significant natural landscapes throughout the State. These areas may be the best examples of a particular habitat, rare species locations, or geological and archaeological sites. The Office of Nature Preserves within the Department of Natural Resources and Environmental Control administers this voluntary program. Efforts are directed towards public and private landowners of natural areas to conserve and protect the resources of concern through the placement of restrictions on the property. Once a natural area has these legally recorded restrictions applied to it, then it becomes a nature preserve and is afforded the highest level of protection for conservation lands in Delaware. The entire upper Blackbird Creek component is within a state-recognized natural area. Activities associated with the DNERR's process will be coordinated with natural areas protection efforts.

CONSERVATION EASEMENT

A conservation easement as defined by Delaware law (7 Del. C. Chapter 69) is a way for a landowner to voluntarily place permanent restrictions on the future use of the land, thereby protecting its natural attributes. The conservation easement is perpetual and binds all present and future owners of the land. For site acquisition/protection efforts, a conservation easement will be one of the methods used to establish the DNERR.

EROSION AND SEDIMENT CONTROL/STORMWATER MANAGEMENT

On July 1, 1991 new state Erosion and Sediment Control and Stormwater Management Regulations will go into effect. These regulations are aimed at significantly reducing pre- and post-construction sediment, nutrient and toxic loads to the State's waterways. Any facilities development associated with DNERR would come under these regulations. Also any development outside of the DNERR boundary would be similarly regulated.

RARE SPECIES AND NATURAL COMMUNITIES

A proposed revision of the State's Endangered Species law would provide additional protection to the many state-listed rare plants, animals and natural communities. All activities in the DNERR, including research, will be evaluated against any adverse impacts to the listed species and communities and modified accordingly.

WILDLIFE AND FISH MANAGEMENT

All wildlife and fish management taking place within the DNERR will adhere to the most current hunting and fishing regulations and laws (7 Del. C. Chapters 1-27).

LAND USE AND ZONING

All applicable state and county land use and zoning restrictions will apply to the DNERR.

XIII. EDUCATION/INTERPRETATION PLAN

The Education and Interpretation program joins Research, and Resource Protection as the three main sections planned for the management of the Reserve components. This shows the close interrelationship between each of these facets.

These programs broaden the public's understanding of the value of estuarine resources, increase citizen awareness and understanding of estuarine management, problems, and issues, advocate positive environmental practices, and interpret and disseminate useful research results to appropriate decision makers.

A. GOALS OF THE EDUCATION/INTERPRETATION PROGRAM

Education Goal

Enhance public awareness, understanding, and wise use of estuarine resources in the Middle Atlantic Region and encourage an environmental ethic among all users.

Education Objectives

* Promote knowledge of the Reserve, its resources, and its programs as well as knowledge of broader coastal issues and concerns related to estuarine management and protection;

* Provide educational and interpretive services at appropriate Reserve components directly to students, managers and visiting public;

* Use information on past lifeways to make members of the public more aware of the importance of estuarine ecology and to promote balanced use of estuarine resources;

* Promote the preservation of historic properties (including archaeological sites, buildings, and structures) through public education efforts;

* Provide opportunities for teacher training, student projects, internships, and assistantships where enrollees work jointly with scientists, gain field experience, and learn about the importance of research resources;

* Provide appropriate facilities which contribute to educational interpretative, volunteer, and research uses of reserve components; and

* Provide an understanding and appreciation for traditional resource uses, such as fishing, hunting, trapping, and boating.

Reserve components will be utilized, where appropriate, as outdoor instructional areas for educational studies in estuarine ecology. The reserve program will help foster a long-term

commitment to the restoration and protection of the Delaware Bay system and its resources through education about the Bay system, the problems facing it, and the policies and programs designed to help the Bay by providing opportunities for interpretive, recreational, and leisure activities (hiking, bird watching, canoeing, etc.). These activities will be promoted at appropriate reserve sites where the natural area character of the Reserve and ongoing research will not be adversely affected.

B. FRAMEWORK OF EDUCATIONAL PROGRAMS

The International Conference on Environmental Education held in Belgrade (1975) and Tbilisi (1972) adopted the following goal:

"To develop a citizenry that is aware of, and concerned about the total environment and its associated problems, and which has the knowledge, attitude, motivations, commitment and skills to work individually and collectively toward solutions of current problems and the prevention of new ones."

We find this goal to be as valid today as when it was first written. Our role as the DNERR environmental education and interpretation program is to further this goal by being a part of a network of delivery systems in the state, nation, and world.

In furthering this goal the Delaware Environmental Legacy Report (1988) indicated that needs showed there should be two major environmental education efforts in Delaware. One for developing an environmental ethic in our youth and a second for recognizing that environmental education is a continuing process and should therefore also target adults and their understanding of the environment.

The DNERR program will address both of these environmental education efforts. It can do this first, by recognizing that for youth in kindergarten through 12th grade the effort should be to develop an awareness and attitude toward responsible environmental stewardship. Second, for adults, continuing education should occur for general public as well as for various selected groups such as the managers, professionals, decision makers, farmers, users, seniors, etc. and for support for higher learning. It should include the development of basic concepts about the environment as well as programming for specific environmental issues.

This program will use the DNERR resource base and participatory involvement to help people understand the interactions and interdependencies between people and the environment. With this knowledge people will understand the consequences of their actions and become motivated to act on them.

It is expected that the DNERR will provide programs which will progress from environmental awareness through environmental

understanding to environmental action.

To meet the goals of the education program, both the Blackbird and the St. Jones components will be available for educational activities. The St. Jones component will be the site of the DNERR Education and Research Center and therefore will provide the resources for most of the educational programs.

Environmental education refers to the total environment including natural, cultural, and historical components. This program will include each of these components in its programming. The impact of humans on nature cannot be ignored and for society to solve its problems it must be addressed.

One major purpose of the educational program of DNERR is to provide educational programs that will facilitate the information exchange between the DNERR researchers and the end users and decision makers. It is the role of the educator not only to take the information discovered by the researchers and make the potential users and decision makers aware of this discovery, but also to assure that they have an understanding of the interrelationships involved so that they can then properly act on the discovery.

C. TYPES OF PROGRAMS

1. Activities

Both the Blackbird and St. Jones components will be able to provide a variety of educational opportunities. Activities at each component will be structured to take advantage of that component's resources. Examples of possible environmental education and interpretation programs include:

* Guided and self-guided tours that will emphasize natural, cultural and historical features. Self-guided tours may be available for anyone including general public visitors while guided tours are usually scheduled.

* Participatory, interactive, and multi-sensory educational activities.

* Archaeological educational activities such as a sample archaeological excavation. These activities are designed to demonstrate the research techniques, as well as showing the continued interrelationships of people with this environment. With careful coordination with professional archaeologists, actual sites can sometimes be used however more commonly a simulated site is developed.

* Tours, demonstrations, and talks on research that is being or has been conducted at the Reserve. Researchers have a direct role in the education program and should frequently be involved in conveying this material to the appropriate

audiences. Educators also help present research results.

* Guided tours and activities in the marsh, river, and bay portions of the estuary. These may use canoes or research and education vessels.

* Educational programs that help students understand the use of research procedures or "teach-ins" that may help educate end users or decision makers on estuarine research and systems.

* Educational materials, programs, and facilities that will aid institutions of higher learning in their use of DNERR.

* Internships for research and for education. The DNERR provides an ideal site for students to intern to develop their research and research application skills. Educational interns with the DNERR Educational Program will have opportunities to work with varied age groups in numerous settings providing an excellent opportunity for professional development.

* Teacher training workshops or "in-service" programs will provide teachers the opportunity to become aware of educational resources available to them as well as to continually upgrade teaching techniques. Delaware is currently considering requiring teacher training for re-certification. If adopted, this could create a significant demand for these programs. Most surrounding states in the region already have such a requirement.

* Production of interpretive and educational materials such as brochures, newsletters, articles, slide-shows, videos, etc.

* Outreach programs on estuarine systems for youth. Bus costs seem to be one of the main reasons why schools limit trips to environmental education sites. Outreach programs of taking the material to the school is often a substitute. In addition, when a school schedules a visit to the Reserve, the outreach program may develop pre-trip and post-trip visits to the school to provide a much more meaningful and complete experience.

* Adult programs for DNERR research efforts and findings, resource protection, management and educators can be presented on-site and as part of the outreach program.

* Educational program involvement in research efforts. This can often help both activities and will be encouraged where feasible.

* Programs (as well as facilities) will be especially developed to be accessible by the handicapped whenever possible. Special consideration will be given to activity

location, activity selection, etc. to provide for maximum program accessibility.

* Activities emphasizing interaction with the resources such as seining, marsh sampling, bay study, marsh ecology, etc. along with related follow-up laboratory experiences.

* Center exhibits to provide an aid to the educational programs.

* Wayside exhibits on-site of specific resources to help explain the site, system, or the research being conducted there.

2. Exhibits

The planned St. Jones component of the DNERR includes the John Dickinson Mansion & Plantation. This mansion is operated by the Delaware Division of Historical and Cultural Affairs. Due to the close proximity of the mansion to the DNERR Center and since the John Dickinson plantation historically provided a cultural link to the estuary, the mansion provides an extra opportunity for public accessibility of DNERR educational materials.

The plantation is open to the public daily (except Mondays) and provides public tours of the mansion. It is planned that as a part of DNERR an outbuilding of the plantation will be expanded to include DNERR exhibits. This exhibit theme will be the cultural link between people and the estuary in the past and continue the time to present environmental concerns.

Since the DNERR does not plan to emphasize general public casual visitation at its Center, the plantation exhibits will provide for much of this visitation. An additional benefit of this linkage is in cost savings. The plantation site is already staffed during normal general public visitation hours including weekends. This will free DNERR education staff for regular educational programs.

It is expected that some exhibits will also be housed at the Education and Research Center. These exhibits are intended to (1) continue the link developed at the plantation site and carry it to present environmental concerns and prevention of environmental problems, (2) support exhibits for the educational program e.g. teaching collections, live collections, concept development, etc., (3) exhibits relating to research being conducted at the DNERR components and (4) related exhibits developed by cooperating agencies.

Longevity of these exhibits are expected to vary greatly with some expecting to be long term support exhibits while others may be short term or seasonal ones.

Wayside exhibits are also planned for both the Blackbird and St. Jones components. These exhibits are located on the site of

various resources that should be interpreted. They help viewers identify the items they are observing, understand the systems underlying the resources or may explain the research project under way for that site.

These wayside exhibits are typically fiberglas embedded signs, metal photo signs, or shelters.

3. Trails

Trails will be constructed on both the Blackbird and St. Jones components. Trails can provide for a unique recreational experience, an area for research and educational program access, and for access to and/or between points of interest.

DNERR trails will provide access to the marsh, water, research sites, educational teaching stations, vistas, etc. One trail will be constructed to provide access from the John Dickinson Plantation to the Education and Research Center. Boardwalks may be a necessary part of the trails to provide access over wet areas.

A St. Jones Greenway has been proposed that would combine efforts from state, county, and city governments, private properties, as well as the DNERR . This function is expected to be compatible with the overall purpose of DNERR. The specific impact on the St. Jones component has not yet been determined but is likely to be a trail paralleling the river. Access to this trail will be determined in conjunction with the overall Greenway plan and with DNERR policy.

Trails will be loops whenever possible. This will reduce maintenance costs as well as provide for increased user interest.

Unless specifically authorized, trails will be for pedestrian use only. No bicycle, horse, or motor vehicle use will be permitted without the written authorization of the reserve manager.

4. Individual Components

a. St. Jones Component

Since this component will house the Reserve Center, it will be the location for the majority of the education and interpretive programs conducted. The DNERR estuarine educator will operate from this center and will develop site specific programs and materials. Trails, boardwalks, and outdoor teaching stations will be located here and may provide extra facilities for convenient outdoor instruction. Boat docks with access for canoes as well as loading space for a research and educational vessel may also be on this component.

b. Blackbird Component

This area will emphasize self-guided, self-conducted tours and activities. Resources will be available for schools and other groups to utilize the facilities without the direct supervision of the DNERR education staff. Staff instructed programming will be conducted for this component to provide the appropriate contrasts for portions of an estuary with less salinity.

5. Themes

The major themes for the DNERR includes reserve awareness, natural resources, estuarine systems, interactions between people and the estuary, and Reserve management.

6. Coordination

a. Coordination of DNERR

Education Coordinator will coordinate education programs for the DNERR. The DNERR Education Coordinator will be the Chief of Interpretive Services who operates educational and interpretive programming from five centers and in locations throughout Delaware. This position will assure coordination of the program with other educational programs, and may be located at DNREC Headquarters as well as operations from the DNERR Center.

The Estuarine Educator will direct the educational efforts at both the Blackbird and St. Jones components. This position will be housed at the Education and Research Center and will be directly responsible for all interpretation, education programs, special events, etc. for the Reserve. See the Administration Plan for the organizational chart for these positions.

b. Coordination with the NERR System

Information publications will be distributed to the other NERR managers around the United States. Interpretive or Educational materials developed will also be made available upon request. Information will be provided to NOAA periodically for NERRS Status Reports. The Reserve Manager will communicate directly and frequently with NOAA for numerous purposes including education.

c. Coordination with other educational programs

The education coordinator will coordinate the DNERR education and interpretation program with the educational programs of public and private schools, governmental agencies, private organizations, and colleges and universities in Delaware. This coordination will attempt to further the overall goals of environmental education (mentioned previously) as well as the more specific estuarine educational goals of the DNERR.

There are numerous groups in the state currently involved in these estuarine education efforts. They include:

--Public Schools

--Private and Parochial Schools.

--Department of Public Instruction
(Science and Environmental Education)

--Department of Agriculture (Project Learning Tree)

--DNREC - various programs

--Conservation Districts

--Delaware Nature Society

--Delaware Audubon Society

--Children's Beach House

--Bombay Hook National Wildlife Refuge

--and more

Colleges and Universities that have expressed interest include:

Delaware State College

University of Delaware
(Cooperative Extension)

Wesley College

XIV. VOLUNTEER PLAN

The Delaware Department of Natural Resources and Environmental Control (DNREC) has through its Divisions utilized volunteers in its programs for greater than two decades. recently DNREC had hired a volunteer coordinator to assist in the recruitment, placement, utilization, coordination, and recognition of volunteers. In addition the Division of Parks and Recreation has developed a volunteer corps for each of its full time interpretive and educational centers. These volunteers assist with conducting programs, staffing centers, maintaining trails, developing exhibits, preparing brochures, and many other facets of center work.

The Reserve is expected to develop a similar corps of volunteers to help with the various aspects of reserve work, assisting with research projects as well as educational volunteers. It may include trail work, opening and closing the Reserve, security awareness, research efforts and so forth.

It is anticipated that the Department's volunteer coordinator be located in the DNERR Center. This will aid the development of the volunteer corps at the proposed DNERR components by fostering a very close working relationship between staff and the volunteer coordinator.

XV. FACILITIES DEVELOPMENT PLAN

Facilities enhance access and use of Reserves and provide support for education and research programs. The Department of Natural Resources and Environmental Control has a critical need for a facility to locate most of the Department's biologists. The goals and objectives of the DNERR program compliment the Fish and Wildlife scientists needs to better manage estuaries and the activities on adjacent lands that impact them.

A. CURRENT FACILITIES

The most important facility that currently exists is the John Dickinson Mansion and outbuildings including a Visitors Barn located within the St. Jones River component. The facility is operated by the Bureau of Museums and Historic Sites and focuses on the historical and cultural aspects of the John Dickinson Plantation which boundaries nearly coincide with the DNERR St. Jones boundaries.

The only other facilities that currently exists within the proposed Reserve's boundaries are a boat ramp, fishing pier and parking lot on the south side of the St. Jones River operated by DNREC.

Other support facilities exist adjacent to the Reserve such as those located at the Logan Lane and Little Creek Fish and Wildlife areas as well as the education and research facilities and equipment located 6 miles from the Reserve at DNREC's headquarters. Some of their values are discussed in other sections, especially the Research plan.

B. PLANNING AND DEVELOPMENT FOR FUTURE FACILITIES

An Education and Research Center is planned to serve as the focus of the Reserve and the facility to accommodate many of the State's field experts in estuarine management.

1. Site Needs

The first five years of the Management Plan will be concentrated on the development of the Education and Research Center and the expansion of the John Dickinson Mansion's Visitors Barn. Other Reserve facility needs are discussed in various sections of the Plan such as trails, boardwalks, and boat access.

EDUCATION AND RESEARCH CENTER

A survey was sent to approximately 50 agencies, schools, environmental and cultural resource organizations. After interviewing the respondents who indicated an interest in co-locating in an estuarine education an research facility, it was determined that there is a need for a multi-purpose education and research facility of about 20000 sq. ft. to enable the DNREC to meet a variety of needs. These same needs also were outlined in the Department's strategic plan.

The facility preferred location is on the north side of the St. Jones river between the Dickinson Mansion and the Department's Logan Lane Tract. The estimated cost is projected based on Kent County building costs and would include: architectural and engineering costs for an expandable structure, septic, well, interior plumbing, electric, heating and air conditioning, finished interior walls and movable floor to ceiling partitions, ceiling and floors, as well as all site access, parking, and landscaping needs. The building will be in the Mansion's historic zone which will require the portion facing the Mansion to be "historically" in context, while the rear (facing the marsh and the St. Jones River) will be glass, open and highly functional.

The building will be phased with the laboratory wing and central services in Phase One with construction paid by state and federal funding . The State and federal funds will continue to be used for the Second Phase which will include the construction of the Education section and the finishing of offices, public display areas, auditorium, conference rooms, resource library, and other education and interpretation facility needs.

Federal funds are authorized to match equally State funds for the construction of NERRS facilities. The DNERR Education and Research Center will accommodate many estuarine specialists who will greatly enhance the DNERR and NERRS programs. Some of these specialists that will be located full time at the Center will have job duties outside of the objectives of the DNERR. Therefore, the State will fund the Center at more than 50% of the construction cost based upon NOAA/State allocation plan.

CONSIDERATIONS FOR PHASE ONE (information from Architect's scoping plans)

DNERR Management and Operations

	TOTAL	DNERR	DNREC
- 7 Offices =	700 sqft	400	300
- Library =	1000	1000	
- Storage,Halls, utility,displays, class/conf. rooms restrooms,etc =	3900	3750	150

DNERR Research
Fish & Wildlife Scientists (including DNERR visiting researchers)

	TOTAL	DNERR	F&W
- Chemistry Lab =	800 sqft	400	400
- Biology Lab =	800	400	400
- 24 Offices =	2000	400	1600
- Storage,halls etc =	2400	1800	600

DNERR Education

	TOTAL	DNERR	P&R
- Education Lab =	1000 sqft	1000	
- 8 Offices =	800	300	500
- Storage,halls, etc =	1000	900	100
TOTAL =	14400 sqft	10350	4050

DNERR FACILITY NEEDS
(based on DNERR survey results)

1. A. Display space__1__yes____no B. Sales area__1__yes____no
   Occasional__Y__ Permanent__Y__

2. Group space
   A. Conference rooms__2__yes____no ; capacity_50_each_seats
   B. Auditorium __1__yes____no ; capacity_200__seats
   C. Classrooms __2__yes____no ; capacity_35_each_seats
   D. Library __1__yes____no ; size_800__sq ft
   E. Outdoor classroom/Lab__4__yes____no
   F. Amphitheater __1__yes____no ; capacity_200__seats
   G. Observation
      a. Deck__1__yes____no
      b. Tower_1___yes____no

3. Office space__Y__yes____no
   number of offices__25__ ; approximate sq ft_5000_
   (for 50 FTE's;including swing & rental off.)
   DNREC DM = 7 people (A,PM,EC,AQ,RC,VC,S,)
   Div. of F&W = 25 people
   Div. of P&R = 2 people
   Rental = 12 people (NACD,Wesley,UofD Ag)
   Swing = 4 people (DNS,SJRWA,other non-profits)

4. Laboratory space
   A. Educational__1__yes____no ; _900_sq ft
   B. Biological __1__yes____no ; _600_sq ft
   C. Chemical __1__yes____no ; _400_sq ft
   D. Visiting scientists__1__yes____no ; _200_sq ft

5. Storage space__1__yes____no ; _2000_sq ft

6. Dormitories
   A. Youth____yes__X__no ; capacity_____
   B. Adults____yes__X__no ; capacity_____

7. Outside needs
   A. Parking__50__spaces ;B.visitors_100__maximum spaces
   C. Loading dock__1__yes____no

8. Location needs (within St. Jones DNERRS Site)
   A. Water access__Y__yes____no ; type of boat_canoe___
   B. Wooded__Y__yes____no ; C. Open__Y__yes____no
   D. Farmlands__Y__yes____no
   E. Wetlands__Y__yes____no

9. Other needs (This is a listing of a variety of needs that may arise - please check all that might be of interest to you. Feel free to add any others.)
   A. _Y_Special water purity
   B. _Y_Climate control
      a. Air conditioning_Y_
      b. Humidity_Y_
      c. Heating_Y_
   C. _Y_Computers
   D. _Y_Printers
   E. _Y_Photocopiers
   F. _Y_Laboratory equipment
      a. Balances_Y_
      b. Microscopes_Y_
      c. Ovens_Y_
      d. Furnaces_Y_
      e. pH meters_Y_
      f. Other_Water analysis kits; Exhibit lighting; Tissue preparation machine; Walk-in freezer & refrig.; Weight scales 300 # cap. wf-lift_____
   G. Specialized major equipment such as :
      a. Carbon-nitrogen-sulfur analyzer_Y_
      b. Particle counter_Y_
      c. Liquid scintillation counter___
      d. Electromagnetic current meter_Y_
      e. Spectrophotometer_Y_
      f. Fluorometer_Y_
      g. Other_Vacuum filter system; Chemical hood; Cryotome____
      _____
   H. Small boats :
      a. Size(length)__18_ft____
      b. Outboard size(h.p.)_40___
      c. Carrying capacity(lbs.)_1800___
      d. Primary uses_Collection of data; I & E Tours_____

I. Field Hydrological Monitoring :
   a. Fixed station,continuously-recording tide gauge_Y_
   b. Portable water level recorder_Y_
   c. Fixed station,continuously-recording current meter_Y_
   d. Portable flow meter_Y_
   e. Fixed station,continuously-recording salinometer_Y_
   f. Portable salinometer,refractometer_Y_
   g. Fixed-station,continuously-recording thermometer_Y_
   h. Portable dissolved oxygen meter_Y_
   i. Portable pH meter_Y_
   j. Secchi disks_Y_
   k. Water collection bottles(Niskin,Kemmerer)_Y_
   l. BOD sampler_Y_
   m. Other_Fixed station continuously recording dissolved oxygen meter_____

J. Field collection gear :
   a. Fish seines_Y_
   b. Fyke nets,hoop nets_Y_
   c. Otter trawls_Y_
   d. Benthic grabs,corers,dredges_Y_
   e. Benthic sieves,strainers_Y_
   f. Plankton nets_Y_
   g. Other_Cannon or rocket nets; Radio telemetry equipment_

K. Weather station_Y_
L. Boat docking facilities_Y_;a.dry_Y_b.wet_Y_c. ramps_Y_ d.piers_Y_
M. Aquariums_Y_ a.salt_Y_ b.fresh_Y_
N. Plant & animal collections_Y_
O. Trails_Y_
P. Shelters_Y_
Q. Observation blinds_Y_
R. Information kiosks_Y_
S. Recreational equipment_Y_
T. Canoes_Y_
U. Ranger residence_Y_
V. Food service_Y_
W. Kitchen_Y_
X. Boats_Y_
Y. Vehicles_ATV's_
Z. Tractors_Lawn mower__Snow_removal_
AA. Heavy equipment_____
AB. Fuel storage_Y_

AC. Equipment storage_Y_
AD. Security_Y_;personnel_Y_equipment_Y_
AE. Other_____

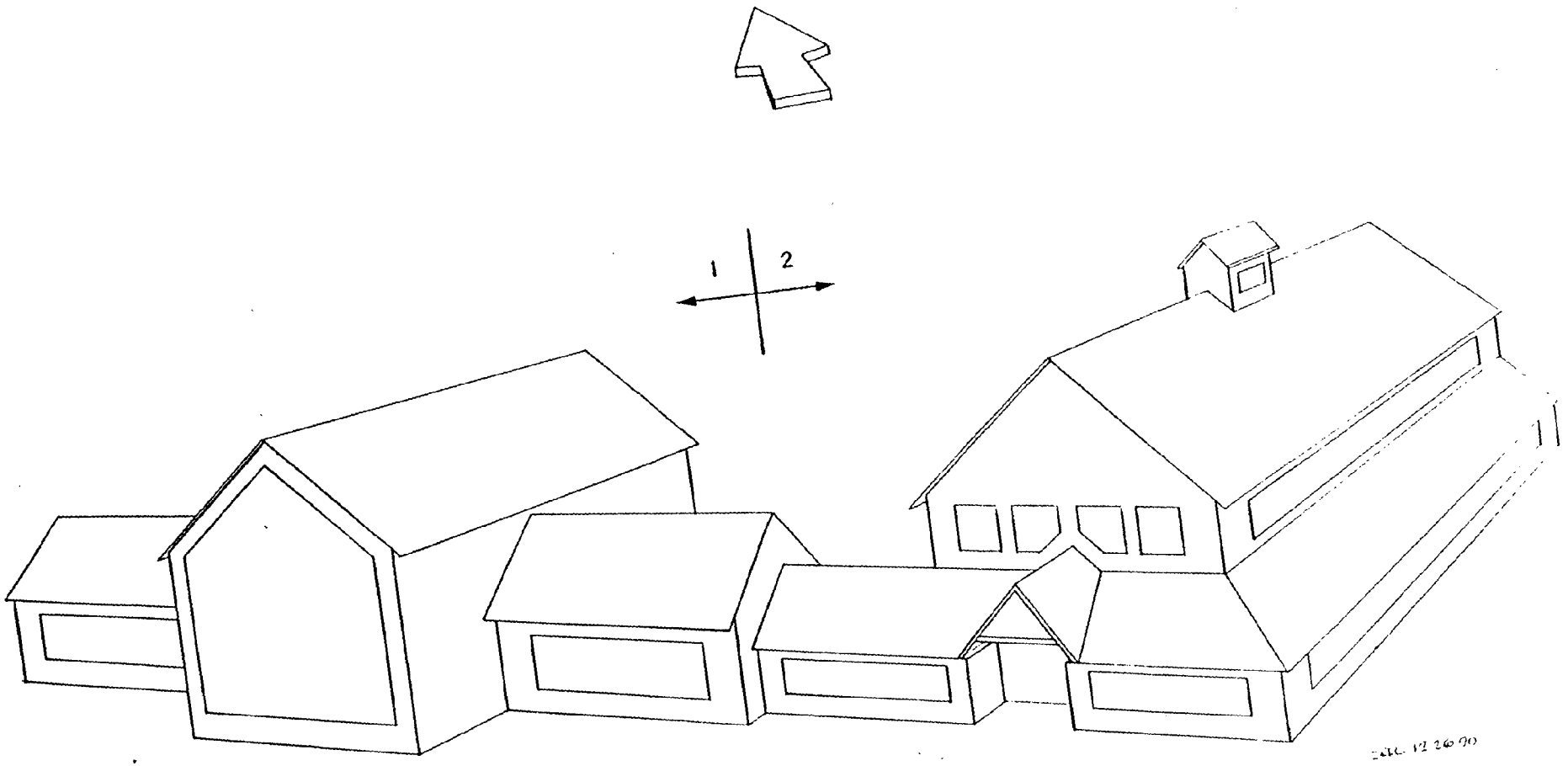
10. Comments :

Summary needs of the DNERR Education & Research Center:

22500 sq ft (Common space = halls - 2000; display-1000; sales - 200; auditorium/conf/classrms - 8000; restrms - 400; lobby - 1000; = 14600 sq ft + 9900 sq ft individual needs = offices - 5000; library - 800; ed lab - 900; bio lab - 600; chem lab-400; visitors lab - 200; storage - 2000).

Note: These figures have been modified by an architect's scoping of the Center. Further modifications are expected during the detail design phase.

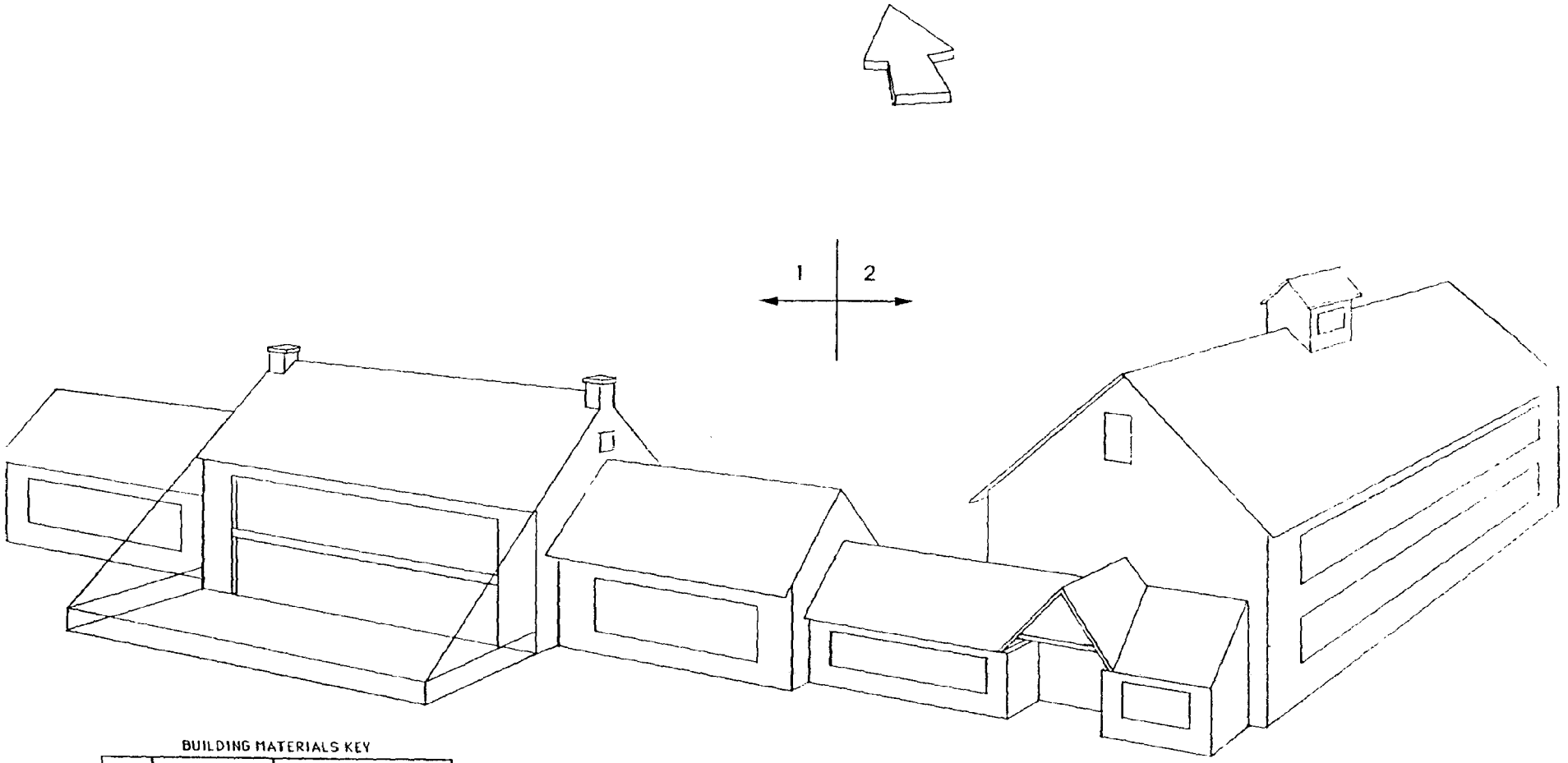
(see figures 8 - 13 for alternative conceptual plans).



BUILDING MATERIALS KEY		
Block	Walls	Roof
1	Brick/Stucco	Wood/Asphalt Shingle
2	Wood/Stucco	Standing Seam Metal/ Asphalt Shingle

FIGURE 8

DNERR Education and Research Center
Alternative Conceptual Plan
(Exterior)



BUILDING MATERIALS KEY

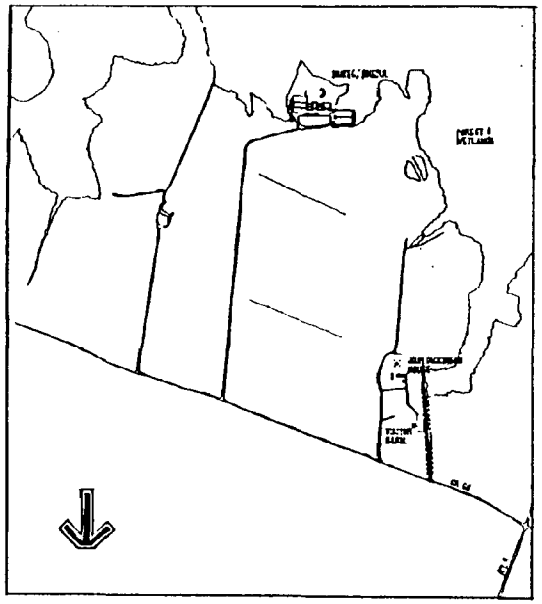
Block	Walls	Roof
1	Brick/Stucco	Wood/Asphalt Shingle
2	Wood/Stucco	Standing Seam Metal/ Asphalt Shingle

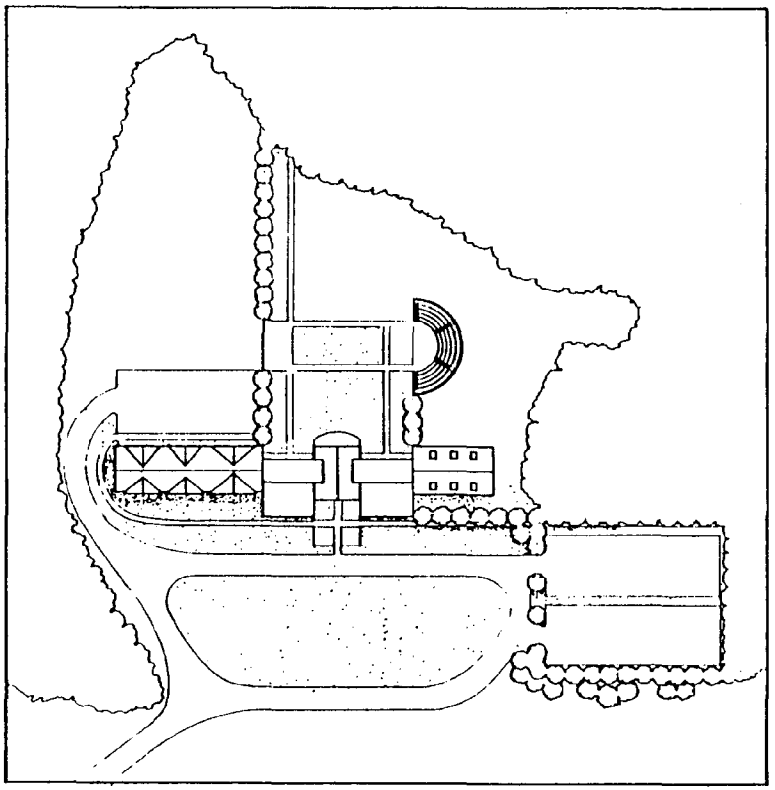
FIGURE 9

DNERR Education and Research Center
Alternative Conceptual Plan
(Exterior)

FIGURE 10

DNERR Education and Research Center
Alternative Conceptual Plan
(Preliminary site)





Moeckel Carbonell
Associates Inc.

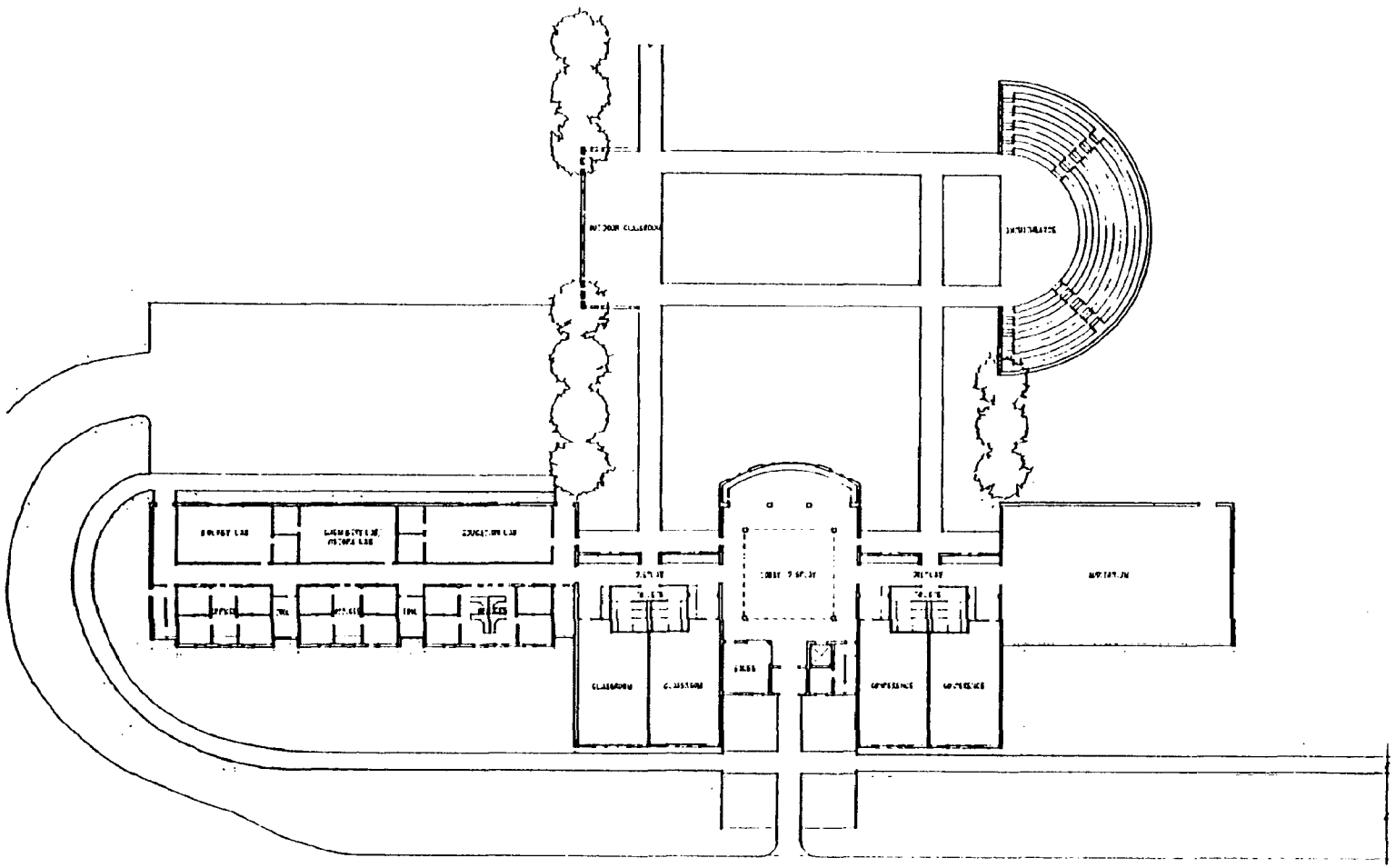
Architects

PRELIMINARY SITE
PLAN

1" = 50'-0"

DEPARTMENT OF
NATURAL RESOURCES

Delaware National
Estuarine Research
Reserve



Moeckel Carbonell Associates Inc.

Architects

PRELIMINARY FIRST FLOOR PLAN

1/16" = 1'-0"

FIGURE 11

DNERR Education and Research Center
Alternative Conceptual Plan
(Preliminary first floor plan)

DEPARTMENT OF NATURAL RESOURCES

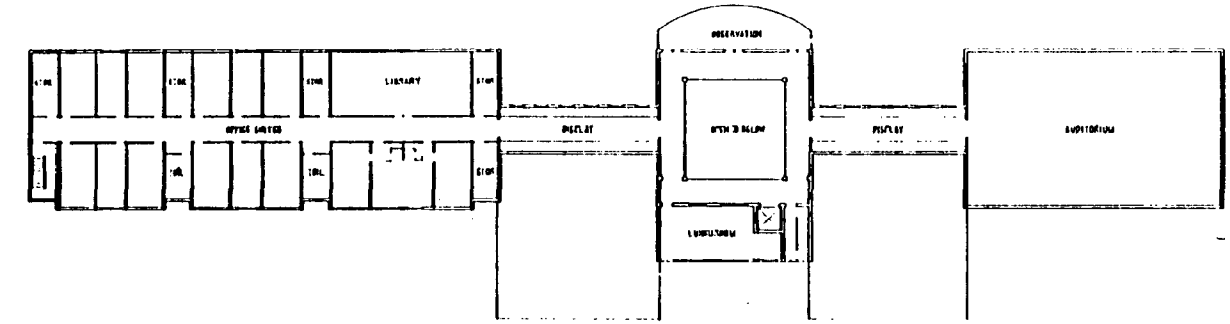
Delaware National Estuarine Research Reserve

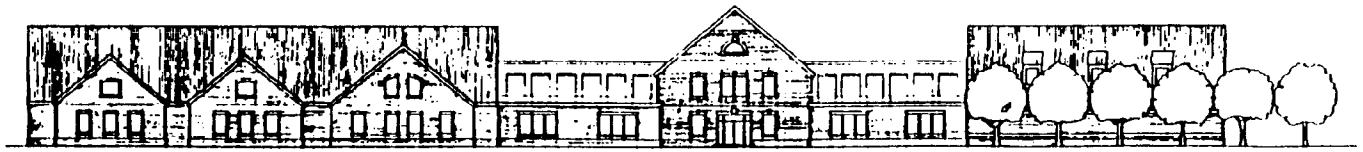
Moeckel Carbonell Associates Inc.

Architects

FIGURE 12

DNERR Education and Research Center
Alternative Conceptual Plan
(Preliminary second floor Plan)





PRELIMINARY
SECOND FLOOR PLAN
AND ELEVATIONS

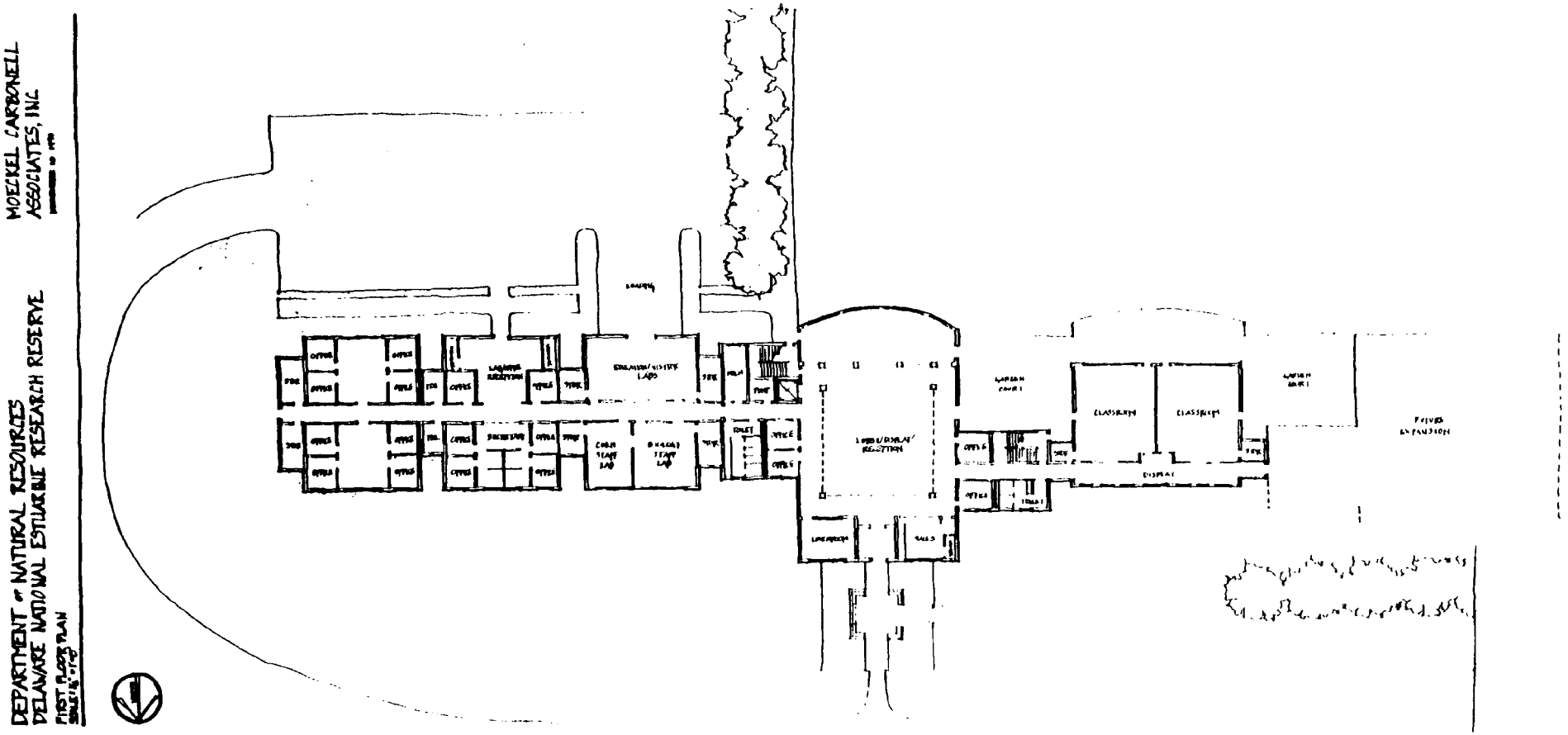
1/16" = 1'-0"

DEPARTMENT OF
NATURAL RESOURCES

Delaware National
Estuarine Research
Reserve

FIGURE 13

DNERR Education and Research Center
Alternative Conceptual Plan
(Alternative one story floor plan)



The DNERR Center serves two key Department objectives: the need to replace the historic "Stone Tavern" with a modern efficient environmental field research and operations Laboratory; and the need to address the educational program required to develop an "environmental ethic" among all users of our fragile coastal ecosystems.

The Department does not have a facility which will permit the public display of the many programs offered for coastal resource management. The Department's Fish and Wildlife scientists are operating out of a building in excess of 150 years old with 3 to 4 individuals assigned per room. In addition, a wet laboratory is necessary, particularly for fisheries scientists who operate out of a totally inadequate, poorly functional space in the Tavern. When hazardous chemicals are used, the entire building is at risk of contamination. There is no space available for educational or interpretative needs and demands of academic institutions, public groups and organizations.

The development and operation of a Delaware Estuarine Reserve Education and Research Center provides a forum for collaboration of the State's efforts in Resource Protection, Environmental Education, Applied Research, and Historical and Cultural Preservation. Multi-departmental objectives will be accomplished. The federal NERRS financial and technical assistance will link Delaware's estuarine management efforts both regionally and nationally for the achievements that shared technology will bring.

Consequences of Not Funding

The major concern if funding is not obtained is the means by which required scientific research and education can be effectively achieved. The current building is suspect in relation to building and safety standards. Existing staffing is already beyond available facilities (Staff Scientists are operating out of their homes and briefcases). The efficiency of DNREC's Fish and Wildlife scientific expertise will continue to be compromised at the expense of our diminishing natural resources.

The lack of required matching funds will prevent the opportunity to maximize DNREC's natural resource management expertise and the need to meet the demands for information and solutions to coastal resource degradation that decision makers require.

There is no other state-owned space available in the central state area. Due to the specific use of this facility for coastal education, research, offices, labs, and habitat access there is no lease/purchase or long-term lease arrangement available and cost effective.

Major renovations and addition to the Stone Tavern are not feasible due to insufficient land, historic status of the building, and high renovation cost that would apply to any retro-fitting of an existing structure that this project would entail.

Alternative locations outside the boundaries of the DNERR components would not be eligible for federal assistance.

VISITORS BARN EXPANSION

The John Dickinson Mansion's Visitors Barn is planned to be expanded to include an area that will be dedicated to the Reserve. The location of the Barn is within the St. Jones component and is ideal for receiving casual visitors. The State Bureau of Museums and Historic sites will present a historical and cultural use of the Reserve with an overview of the estuarine values that have been important to these uses. This will allow the focus of the Education and Research Center to receive visitors that have more than a casual interest in estuarine management and uses.

2. Costs

Education and Research Center

Architecture/Engineering	$ 165,000
Construction	2,500,000
Contingency	100,000
Furniture	50,000
Telephone Equipment	10,000
Computers	50,000
Laboratory Equipment	115,000
TOTAL	$2,990,000

Visitors Barn Expansion

Architecture/Engineering	$ 9,000
Construction	100,000
Contingency	5,000
Furniture	2,000
Displays	10,000
TOTAL	$ 126,000

3. Environmental Assessment and Engineering Report

The Education and Research Center will be located as close to the tidal wetlands of the St. Jones River as practical (there will be no wetlands disturbance). In order to achieve this desired location, the structure will be in or near the 100 year flood zone and near the effects of shoreline erosion. The facility will be designed to be located on upland that is currently cleared agricultural lands with a buffer zone that will protect the effects of the projected 100 year migration of the shoreline. The structure will be elevated above the projected flood elevation. The Center will be located within the historic Dickinson Plantation. A section 106 Pre-construction Historical and archaeological investigation will be performed. Any historic or pre-historic sites that may be disturbed by the construction of the Center will be mitigated.

The Center site location is between two runway approaches of the Dover Air Force Base. The Air Installation Compatible Use Zone (AICUZ) study prepared by the Base indicates that the preferred Center locations are not within accident potential zones nor within intolerable noise level areas. Also to be noted that the development of the Center and the operation of the Reserve will not increase hazards to the aircrafts such as increased bird populations that could cause problems to jet engines.

C. SCHEDULE FOR CAPITAL IMPROVEMENTS

Years:

YEAR 1

Education and Research Center
Design & Engineering.....$ 165,000

YEAR 2

Education and Research Center
Site Preparation & Construction.....$1,500,000

Visitors Barn
Design & Engineering.....$ 9,000

YEAR 3

Education and Research Center
Construction, Furniture & Equipment.....$1,325,000

Visitors Barn
Site Preparation & Construction,
Furniture & Displays.....$ 117,000

D. MAINTENANCE

Education and Research Center

Annual Operating Costs

Maintenance	$ 22,200
Energy	34,200
Roads & Grounds	5,000
Custodial	29,400
TOTAL	$ 90,800

Visitors Barn Expansion

Annual Operating Costs

Maintenance	$ 1,000
Energy	1,500
Roads & Grounds	500
Custodial	1,000
TOTAL	$ 4,000

DNERR EDUCATION AND RESEARCH FACILITY
Total/State/Federal
SCHEDULE FOR CAPITAL IMPROVEMENTS

Years:

	TOTAL	* STATE	* FEDERAL
YEAR 1			
Education and Research Center Design & Engineering.....	$ 165,000	100,000	65,000
1992			
Education and Research Center Site Preparation & Construction.....	$1,500,000	750,000	750,000
Visitors Barn Design & Engineering.....	$ 9,000	-0-	9,000
1993			
Education and Research Center Construction, Furniture & Equipment.....	$1,325,000	706,000	619,000
Visitors Barn Site Preparation & Construction, Furniture & Displays.....	$ 117,000	60,000	57,000
TOTALS	$3,116,000	1,616,000	1,500,000

* State and Federal dollars subject to available funds.

XVI. OTHER ALTERNATIVES CONSIDERED

In addition to the preferred alternative, other alternatives are discussed, including no action, alternative sites, alternative boundaries, and alternative management strategies.

A. NO ACTION ALTERNATIVE

Under the no action alternative, the Delaware NERR designation would not be pursued. The St. Jones River and Blackbird Creek sites are still listed in the Delaware state-wide land protection program, however other funding and management approaches would have to be devised to protect the current values of these estuarine sites.

B. ALTERNATIVE SITES

Several other sites were considered, however these were rejected in favor of the proposed DNERR St. Jones River and Blackbird Creek sites because of their representative ecological diversity of the Middle Atlantic region, compatible land uses in the buffer areas, and the willingness of the private landowners to participate in the development of the DNERR.

C. ALTERNATIVE BOUNDARIES

Alternative minimum boundaries, that encompase regicnal representative ecological units, for the proposed Reserve are considered, however the preferred boundaries encompass entire watershed units and thus are the most desirable.

D. ALTERNATIVE MANAGEMENT STRATEGIES

Alternative management plan options were considered, including establishing management of the Reserve within one of the Divisions of DNREC. The uniqueness of the proposed DNERR requires management responsibilities of the Divisions of Fish and Wildlife, Parks and Recreation, Soil and Water Conservation, and Water Resources within DNREC. Therefore it is logical for DNREC Department Management to be the lead agency that will coordinate with its Divisions, the Department of State's Division of Historical and Cultural Affairs and the many other agences and organizations that will be involved with the operations of the Reserve.

E. ALTERNATIVE FACILITY LOCATIONS

The location of the Education and Research Center was another alternative considered. The St. Jones River site is the preferred location due to its proximity to DNREC Headquarters and other support group offices and facilities. The limiting factors for the siting of the Center within the St. Jones component are the hazard and noise zones of the Dover Air Force Base and the availability of suitable uplands, both of which should be able to be agreed upon to the satisfaction of all concerned parties.

XVII. AFFECTED ENVIRONMENT

LOWER ST. JONES RIVER

A. ST. JONES COMPONENT PHYSICAL ENVIRONMENT

1. Climate

Central Delaware has a climate with well-defined seasons. The Atlantic Ocean, Delaware Bay, and Chesapeake Bay exert considerable modifying influence on the climate. Easterly winds off the Atlantic Ocean and Delaware Bay tend to raise the winter temperature and to lower the normal summer temperature. This temperate, rather humid climate is typical of most coastal areas of the Middle Atlantic States.

The warmest period of the year is the last part of July, when the maximum afternoon temperature averages 89 degrees F. Temperatures of 90 degrees or higher occur on an average of 31 days a year. Extremes of 100 degrees or more can be expected 1 year in 4. The coldest period is the last part of January and the beginning of February, when the early morning temperature averages near 24 degrees. The average number of days when the minimum temperature is 32 degrees or lower is 90. Temperatures of 0 degrees or lower can be expected 1 year in 6.

The annual precipitation averages 46 inches. The monthly distribution is fairly uniform during the year. The average seasonal snowfall (October through April) totals 16 inches,with snowfall ranging from only a trace to more than 45 inches. Drought may occur in any season, but a serious drought is most likely in summer. Thunderstorms average 30 days a year with three-fourth occurring between May and August. Tornadoes average only one a year throughout Delaware causing little damage. Hurricanes occur in Kent County about once a year, usually in the period August through October with minor damages. The prevailing winds are from west to northwest most of the year but are more southerly in the summer. The average annual windspeed is about 9 miles per hour, but winds of 50 miles per hour or more accompany severe thunderstorms, hurricanes, and general winter storms (northeasters).

2. Hydrology

The Lower St. Jones River is tidally influenced, with a mean tidal amplitude at the river mouth of almost 5 feet. (U.S. Dept. of Commerce, 1989). Tidal amplitude is somewhat attenuated upstream in the area of Barkers Landing. River widths within the lower basin typically range from 125 to 200 feet, with channel depths of 5 to 15 feet at low tide.

The expansive tidal wetlands of the lower St. Jones River basin were parallel-grid-ditched for saltmarsh mosquito control during the 1930's, and these ditches were last reexcavated in the

mid-1960's. This grid-ditching radically altered wetlands surface hydrology. While the grid-ditches eliminated some mosquito breeding, the basic engineering concepts of grid-ditching for pest control efficacy were not sound, and today much of the grid-ditched marsh in Delaware must be treated with aerially-applied insecticides and is scheduled for further treatment with newer, more environmentally-compatible techniques having high pest abatement efficacy (e.g. Open Marsh Water Management). Much of the standing water habitat associated with pools and pannes of the marsh surface was lost as a result of the parallel-grid-ditches (which were spaced about 150 feet apart). Today, even though the grid-ditches of the St. Jones River basin haven't been recleaned for 25 years, most of the marsh's aquatic habitat continues to be drained at low tide. Almost all tidal wetlands in Delaware have been parallel-grid-ditched, as has over 90% of the coastal wetlands from Maine to Virginia.

The entire St. Jones River watershed drains an area of approximately 54,000 acres of east central Kent County. Fifty-one percent of this drainage basin is agricultural, 11 percent urban, and 38 percent classified as "other" (primarily forest/woodland). Water quality within the Lower St. Jones River is subject to periodic degradation. Depressed dissolved oxygen levels are common to this section of the river during the summer months, possibly due to natural benthic demand or influx of naturally anoxic water from adjoining wetland areas (DNREC, 1988). Base nutrient levels (nitrogen and phosphorous) are considered to be low to moderate. After the advent in 1973 of the Kent County Regional Treatment Plant on the Murderkill River near Frederica, most all discharges of treated or partially treated sewage into the St. Jones River had ceased by the 1980's. However, PCB levels in fish flesh from the St. Jones River has prompted a human health advisory against fish consumption, in effect since 1988. Salinity levels throughout this section vary seasonally, with a typical range between 3 and 20 parts per thousand, dependent upon distance upstream from Delaware Bay and recent rainfall events.

3. Geology

The St. Jones component is within the Coastal Plain Province approximately 45 miles south of the Appalachian Piedmont Fall Zone. The Piedmont-type rocks are covered by a thick wedge of unconsolidated and semiconsolidated sedimentary rocks. The oldest and most extensive of these sediments are at the base of the Potomac Formation and are about 120 million years old. It consists of color-banded clays with interbedded sands which eroded off the ancestral Appalachian Mountains. The Magothy Formation was deposited next with its very distinct white sands and black lignite suggesting a transitional environment from stream deposits to marine, much like that found in a delta. Layered on top of the Magothy are marine formations of Cretaceous through Eocene age with the Piney Point Formation being the youngest. Above this is an unconformity which represents a gap in the sedimentary record during which no sediments have been

preserved (Oligocene age). Later, the sea again covered most of Delaware and deposited the Chesapeake Group (Miocene age). This group consists of interbedded silts and sands and reaches a thickness of 400 feet at the St. Jones. Many of the sandy layers contain important supplies of water for municipal and industrial use in the Dover area. The repeated advance and retreat of continental glaciers during the past one to two million years (Pleistocene age) caused drastic changes in relative sea level and the configuration of streams draining from the glaciers. The resultant Columbia Group and Formation consists of channel deposits from meltwater runoff which supplies most of the sands and gravel for construction. Sand and gravel are the most important mineral resources in Delaware with the most potential source for Kent County being in and around the St. Jones component area.

4. Topography

The St. Jones watershed is a plain that slopes gently upward and westward from the Delaware Bay to the Chesapeake Bay watershed at a high of 72 feet creating a gradient of only 4 feet per mile over the length of the 15 mile watershed. At the reserve component the width of the watershed is only 2 miles with a maximum elevation of 20 feet causing only a slightly steeper gradual gradient.

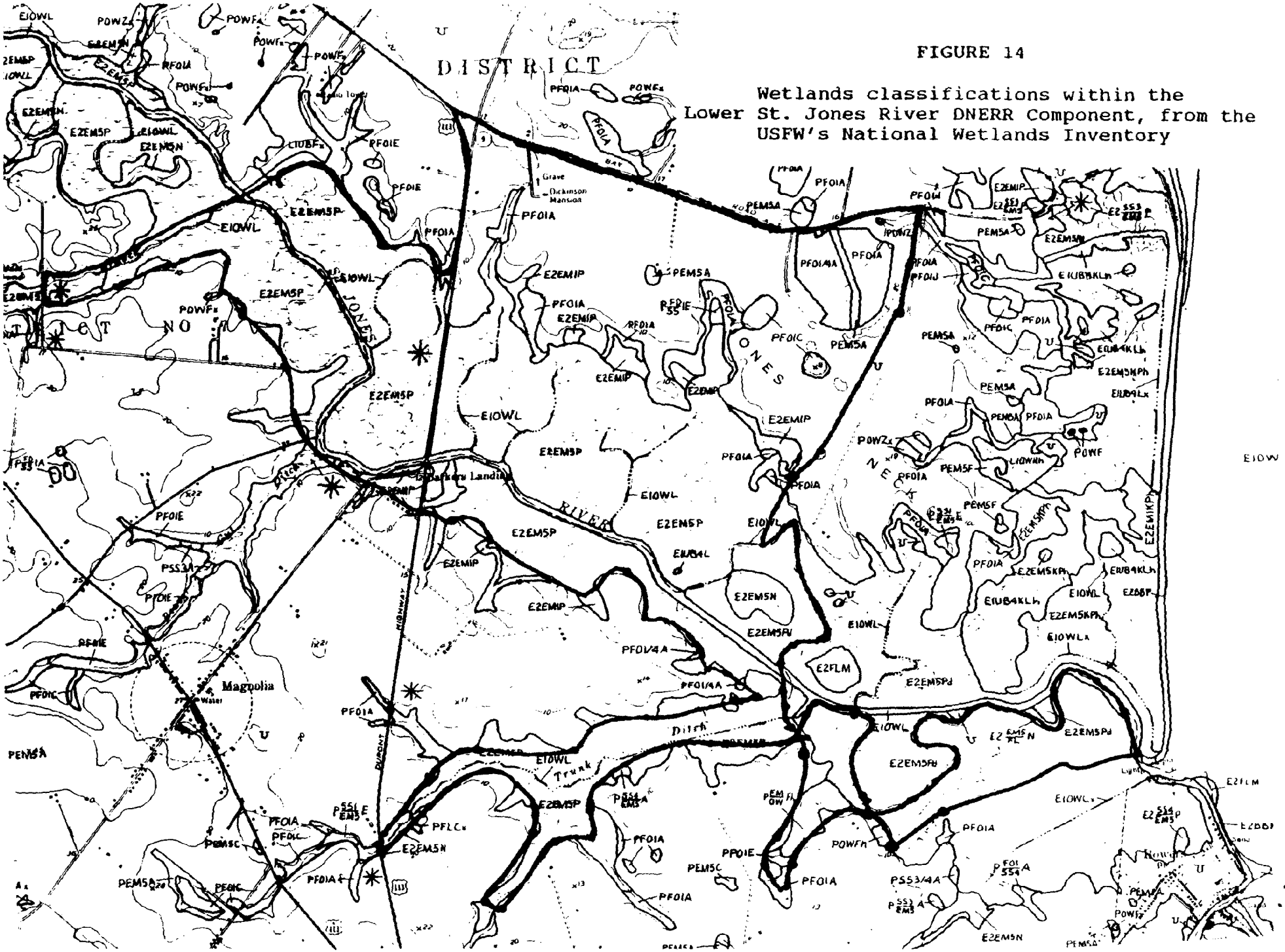
B. ST. JONES COMPONENT BIOLOGICAL ENVIRONMENT

1. Flora

Much of the area adjacent to the river is vegetated by intertidal persistent emergent wetlands, typically extending 500 to 3500 feet from the river's edge. These wetlands are vegetated primarily by saltmarsh cordgrass, Spartina alterniflora, which is Zone I tidal wetlands as classified in An Atlas of Delaware's Wetlands and Estuarine Resources (Daiber et al, 1976). In the Lower St. Jones River watershed, over 90% of the tidal wetlands are Zone I habitat. Patches of Zone II wetlands, dominated by saltmeadow cordgrass (Spartina patens) and saltgrass (Distichlis spicata) which in combination form the salt hay community, are scattered throughout the higher elevations in Zone I. Big cordgrass, S. cynosuroides, and common reed, Phragmites australis, are found along creekside levees and in the backmarsh near the upland edge. Wetland areas upstream of Rt. 113 at Barkers Landing are vegetated primarily by mixed stands of S. alterniflora and S. cynosuroides. Wetland shrub species (groundselbush, Baccharis halimifolia, and marsh elder, Iva frutescens) also occur in tidal wetland areas of higher elevation. A limited amount of palustrine forested wetlands occur at the head of the numerous tidal creek tributaries to the St. Jones River. Wetland types in the Lower St. Jones River estuary, according to the classification scheme of the USFWS's National Wetlands Inventory, are given in Fig. 14. Some upland agricultural areas are also included within the component.

FIGURE 14

Wetlands classifications within the Lower St. Jones River DNERR Component, from the USFW's National Wetlands Inventory



2. Fauna

The Lower St. Jones River site is the proposed focal component of Delaware's dual-component Research Reserve. Its location adjacent to the intensively-managed Ted Harvey Conservation Area gives the area a diversity and abundance of fish and wildlife as great as any area in the State. In addition, the possible extension of the Reserve boundaries to include an area of nearby Delaware Bay bottom will further complement the diversity of fauna at this component. Based upon surveys conducted on the adjacent State Wildlife Area, nearly 100 species of birds may be found on the Reserve site, including ducks, geese, wading birds, shorebirds, raptors, upland game birds, and song birds. Particular importance is attached to black duck, mallard, gadwall, bluewinged teal, wood duck, bobwhite quail, ringnecked pheasant, American woodcock, and mourning dove because of their importance as game birds and their occurrence as nesting species in the wetlands and upland fringe. Avian species such as the blacknecked stilt, black tern, American avocet, and black skimmer are relative newcomers to the area, and their occurrence is believed to be closely allied to the construction of impounded tidal wetlands on the Ted Harvey Conservation Area. Many incidental or infrequent visitors have also been observed, and provide an annual attraction for many bird watchers from all over the eastern seaboard. Important raptors that have been seen on the site include osprey, peregrine falcon, Cooper's hawk, red-tailed hawk, rough-legged hawk, Northern harrier (marsh hawk), and great horned owl. In addition, at least 11 species of warblers and over 20 species of shorebirds frequent the site in varying numbers during migration periods. The critical nature of the Delaware Bay shoreline just east of the proposed component as foraging habitat for migratory shorebirds, especially during late May and early June when the horseshoe crabs are spawning on the beaches, has led to the designation of this shoreline as part of the Western Hemisphere Migratory Shorebird Reserve Network.

All mammals common to Delaware can be found in the wetlands and forest fringes of the Lower St. Jones River. The white-tailed deer, cottontail rabbit, gray squirrel, raccoon, red fox, opossum, and woodchuck are abundant game animals, while muskrat, mink, and otter are the primary furbearers taken by trappers within the proposed Reserve and adjacent marshes. Hunting and trapping are intensively regulated on the adjacent State Wildlife Areas for public enjoyment, with such activities on the private lands within the proposed Reserve controlled by the property owners. Habitat management within the adjacent State Wildlife Areas has demonstrated successful techniques for maintaining high game populations consistent with an optimum annual harvest.

Many reptiles and amphibians occur on the proposed component. Six species of turtles, several types of snakes, frogs and toads, and salamanders have been found, associated with habitats that range from uplands and forested wetlands to freshwater marshes and tidal ponds. Educational and research opportunities are good for this group of fauna.

The Lower St. Jones River and nearby Delaware Bay bottoms serve as nursery and feeding habitats for many estuarine fish and shellfish. Important commercial and sport fish include white perch, blueback herring, summer flounder, American shad, alewives, menhaden, catfishes, eels, mullet, weakfish, bluefish, and striped bass. Forage and mosquito-predacious fishes are abundant in the main river, tidal creeks and pools, including sticklebacks, sheepshead minnow, bay anchovy, mummichog, and silversides. Both the Lower St. Jones River and adjacent Delaware Bay bottom have historically supported extensive oyster beds which have been seriously depleted in recent years. The blue crab is currently important, both commercially and as a recreational source. There is an excellent opportunity to conduct research necessary to restore or maintain shellfish resources, both at and away from this component.

C. ST. JONES CULTURAL AND HISTORICAL RESOURCES

The St. Jones DNERR component spans the interface between two environmental zones of importance in prehistoric settlement systems. Both the mid-drainage and coastal zones provided favorable settings for large and small settlements, and the diversity of floral and faunal species where these two zones come together provides a particularly rich resource base for hunting and gathering peoples. Sites in this area provide an opportunity to study human adaptation to a developing estuarine environment over more than 8,000 years. In the mid-drainage section of the study area, there is a medium probability of base camps and procurement sites from the Archaic Period (6500 B.C. to 3000 B.C.) and the Woodland II Period (A.D. 1000 to A.D. 1600). There is also a high probability for the entire range of Woodland I Period (3000 B.C. to A.D. 1000) sites. For the coastal segment, there is a medium probability of Archaic procurement sites and a high probability of Woodland I and Woodland II base camps and procurement sites.

A total of 32 prehistoric archaeological sites in the upland areas fringing the marsh along the St. Jones River DNERR component have been reported in the Cultural Resource Survey maintained by the Delaware Bureau of Archaeology and Historic Preservation. In 1978, the entire area was subjected to a reconnaissance level survey conducted by the Kent County Archaeological Society (KCAS), a chapter of the Archaeological Society of Delaware, under a survey and planning grant from the National Park Service. Professional supervision was provided by the Division of Historical and Cultural Affairs (HCA). The survey covered St. Jones Neck (on the north side of the St. Jones River) and the northern portion of Murderkill Neck (on the south side of the St. Jones River. Fieldwork for this survey included controlled surface collection by walking over cultivated fields in parallel transects about 10 meters apart. Each field containing artifacts was assigned a site number. Separate artifact concentrations in each field were defined as subareas and designated by letter.

As a result of this survey, significant archaeological sites on the north side of the St. Jones River were nominated to the National Register of Historic Places as part of a multiple resource nomination for St. Jones Neck. The boundaries of the St. Jones Neck Historic District have been defined to include historical archaeological sites and buildings which preserve elements of the 18th and 19th century architecture and settlement pattern (see figure 15). Architectural survey south of the St. Jones River has been completed at the reconnaissance level, but evaluation is not complete.

In addition to these location/identification surveys, the area around the Lower St. Jones River component has been included in studies which focused on the development and testing of models for prehistoric settlement. The first of these studies was conducted by the University of Delaware Center for Archaeological Research (Custer and Galasso 1983), and was designed to test non-quantitative settlement models for Delaware's Low Coastal Plain. Site data from this study were used to develop a quantitative predictive model for site location using LANDSAT-generated environmental data (Custer, Eveleigh, and Klemas 1983). This LANDSAT-generated model was then tested in a later study (Gelburd 1988).

In the 1980's two studies were conducted that involved archaeological testing in the St. Jones DNERR component area. A survey of the proposed dualization of Rt. 113 between Little Heaven and Dover AFB was completed by the Delaware Department of Transportation (Cunningham 1980). Surface collections from five sites were reported and two sites were recommended for further testing. Site 7K-F-88 contained prehistoric and 17th century historic components, while site 7K-D-35 appeared to be an early Woodland I microband base camp with intact deposits below the surface.

Further research was carried out by the University of Delaware Center for Archaeological Research at the Barker's Landing site (7K-D-13) in 1983. Testing and controlled surface collections revealed that the artifact assemblage came primarily from mixed plowzone/surface contexts. The types of ceramics recovered however were diagnostic of the early Woodland I period and included Marcey Creek, Seldon Island, and Wolfe Neck wares as well as fragments of stone bowls made from steatite. These ceramics represent a time range from 2000-500 B.C. Concentrations of argillite were associated with adjacent fire-cracked rock concentrations. These features also contained steatite sherds, points and bifaces. The production of usable tool forms from argillite blanks was a major activity and may be related to the production of generalized fish processing tools (Custer 1984:10). The Barker's Landing site was located at the oligohaline boundary, or freshwater/saltwater interface, reconstructed for initial Woodland I times (Belknap and Kraft 1977, Custer 1989:223). The rich estuarine resources along the mid-drainage zone provided a highly predictable environment with a high potential for population growth. Consequently the Barker's Landing site became an important social center for the

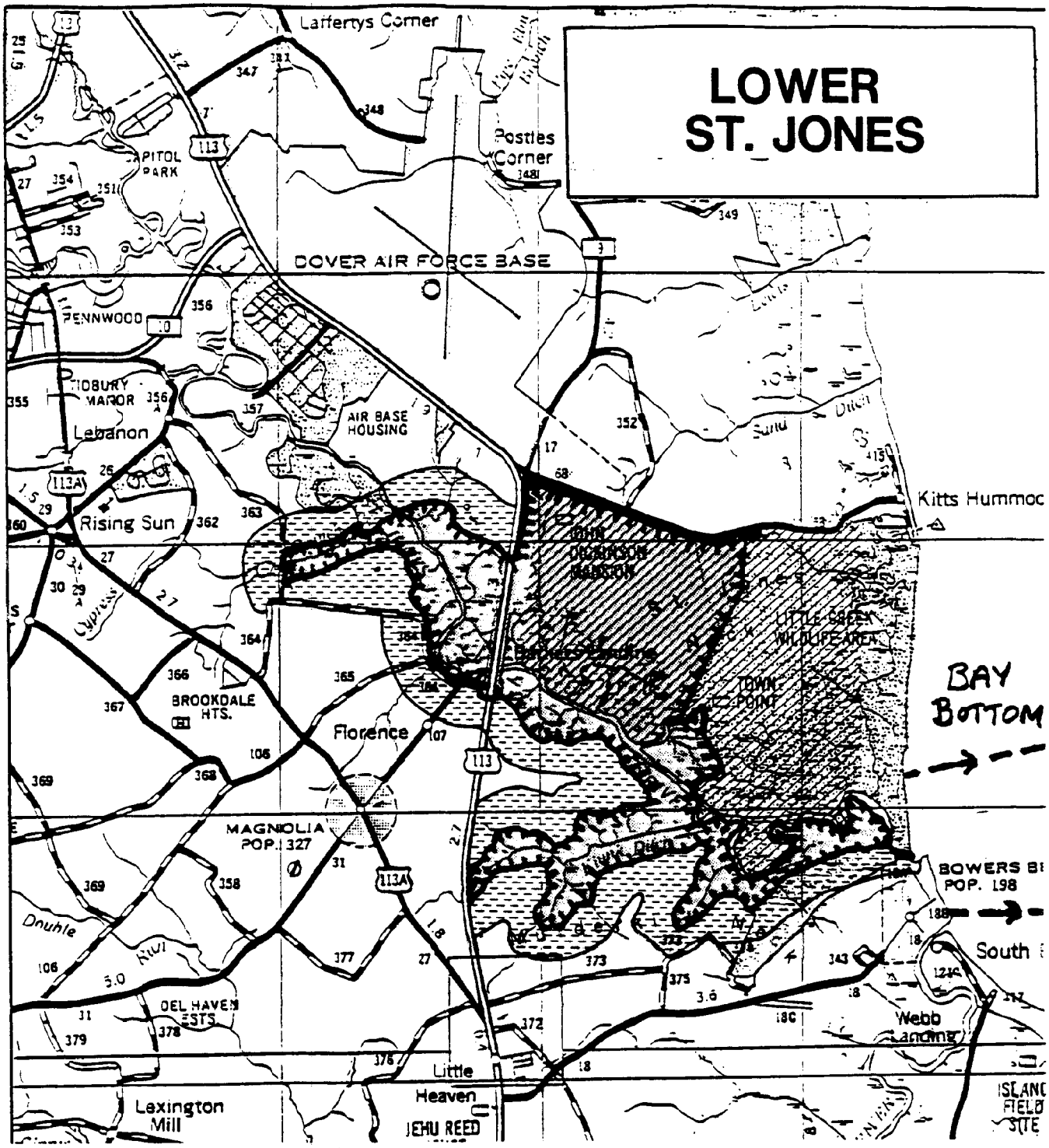


FIGURE 15

Historical and cultural characteristics of the Lower St. Jones River DNERR Component

- LOWER ST. JONES SITE
- LOWER ST. JONES NECK HISTORIC DISTRICT
- ADJACENT PRIVATE UPLAND

processing and redistribution of argillite in the early Woodland I exchange network.

A review of site locations and existing collections from Murderkill Neck on the south side of the St. Jones was conducted by the Delaware Department of Natural Resources and Environmental Control (DNREC) in 1991 in order to provide a more complete evaluation of cultural resources from both sides of the St. Jones DNERR component. This review focused on the mapping and identification of prehistoric site collections from the 1978 KCAS study. Colonial period historic collections, often from the same locations as prehistoric sites, are currently undergoing analysis by Charles Fithian, Curator of Archaeology at the Island Field Archaeological Museum and Research Center. These historic period collections indicate intense occupation beginning in the last quarter of the 17th century.

The majority of the sites are multi-component micro-band base camps. Base camps included ceramics and a variety of stone tools, while procurement camps were more limited in the variety of tools and included no ceramics. At least 20 base camps and 10 procurement sites are present in the study area, while 2 site locations were based on information from local collectors with no other information available. Sites 7K-D-12 and 7K-D-13 are contiguous and represent the only macro-band base camp within the St. Jones DNERR component. Artifact concentrations and features from this site complex were scattered over a half mile wide area. No other sites are as extensive.

Based on the available surface collections, no sites produced any reliable projectiles diagnostic of the Archaic time period (6500-3000 B.C.). Site 7K-D-35 did produce an Eshback point which may be one of the earlier point styles found on St. Jones Neck. A total of 24 sites produced ceramics or projectiles points diagnostic of the Woodland I period (3000 B.C. to 1000 A.D.), while 21 sites produced artifacts diagnostic of the Woodland II period (1000 A.D. to 1600 A.D.). A total of 6 sites were undefined as to temporal period because of the limited size or absence of the collection.

Because the Woodland I period spans so large a time period it is useful to separate this period by diagnostic changes that were occurring in the cultural complexes. These changes are most readily identified by differences in the methods of producing ceramics through time. The early Woodland I, or Barker's Landing complex (2000 to 500 B.C.) is identified with the use of steatite bowls or steatite tempered ceramics. Twelve sites included ceramics or stemmed points diagnostic of the early Woodland I period. This includes 7K-D-6, 7K-D-12, 7K-D-13, 7K-D-35, 7K-D-42, 7K-D-45, 7K-D-47, 7K-D-48, 7K-D-52, 7K-F-13, 7K-F-81 and 7K-F-97. The Barker's Landing site (7K-D-13) was a large macro-band base camp located at the oligohaline boundary c.a. 2000 B.C.. The remaining sites appear to be micro-band base camps.

The Wolfe Neck (500 B.C. to 0 A.D.) and Carey (0 A.D. to 500 A.D.) complexes appear to witness a slight contraction in the

number of sites occupied. A total of six sites produced Coulbourn, Wilgus or Nassawango types of ceramics attributed to the Wolfe Neck complex (7K-F-21, 7K-F-81, 7K-F-93, 7K-D-45, 7K-D-47, and 7K-F-86). Eight sites produced Mockley ceramics characteristic of the early Carey complex (7K-F-13, 7K-F-88, 7K-F-93, 7K-F-96, 7K-F-84, 7K-F-86, 7K-D-45, and 7K-D-47). Macro-band base camps for these respective complexes were relocated two and three miles further upstream as the freshwater/saltwater interface continued to move inland.

The Late Carey (500 A.D. to 1000 A.D.) complex brought a resurgence in the number of sites occupied in the Coastal Zone. A total of eleven sites produced Hell Island ceramics associated with this complex. These sites are 7K-D-6, 7K-D-47, 7K-D-48, 7K-D-58, 7K-F-13, 7K-F-21, 7K-F-81, 7K-F-88, 7K-F-86, 7K-F-93, and 7K-F-96. No macro-band base camps have been found located anywhere on the St. Jones River for this time period, or for that matter, in Kent County. Custer (1989:295) has interpreted the change in settlement patterns for the Late Carey complex as one of groups choosing fission over the social investment and controls necessary for further political evolution. Many questions remain to be resolved as to the ties and relationships between these groups. In particular what were the critical factors that allowed expansion of social groups into the coastal zone again.

The Woodland II period (1000 A.D. to 1600 A.D.) continued the same pattern of population growth in the Coastal zone that had begun during the Late Carey complex. A total of 21 sites produced triangular projectile points or ceramics identified with this period of occupation. Of these sites, 16 included Townsend, Killens, or Minguanon ceramics; however twelve sites produced both the ceramics and diversity of tools associated with base camps. These were 7K-D-6, 7K-D-12, 7K-D-13, 7K-D-45, 7K-D-47, 7K-D-48, 7K-F-86, 7K-F-88, 7K-F-21, 7K-F-93, 7K-F-13 and 7K-F-96. A few small macroband base camps are located on the St. Jones River during the Woodland II period, but most of the larger sites of this time span are located further south along the rivers of the coastal zone. Settlement changes for this period included the disappearance of previous lithic exchange systems, the development of sedentary, or village lifestyles, and the appearance of agricultural food production.

While these studies have served to locate and identify a large number of prehistoric and historic archaeological sites, little has been done to study these sites in detail. None the-less, it is clear that the prehistoric sites along the St. Jones River provide an opportunity to study human adaptation to a developing estuarine setting over more than 8,000 years. Ecological information preserved in datable archaeological contexts in these sites can contribute to a greater understanding of manner in which the St. Jones estuary developed. The historic period sites include the earliest settlements in Kent County (e.g. Kingston-Upon-Hull, Town Point), and offer an opportunity to study the early period of European settlement away from population centers such as New Castle and Philadelphia. The John

Dickinson Plantation and Mansion, on the north side of the St. Jones River and east of Rt. 113, is within the boundaries of the proposed DNERR. The mansion, furnished with antiques, was the childhood home of John Dickinson (1732-1808), "Penman of the American Revolution." The outbuildings and landscaping are done to recreate the property as it was in the early 19th century, and as such the complex is a significant educational and tourist center. These sites also offer an opportunity to study the development of historic patterns of estuarine exploitation.

D. ST. JONES ZONING AND LAND USE

All zoning and land use in the Lower St. Jones River component is Agricultural-Conservation, with exception of an adjacent parcel of 306 acres which is zoned Industrial-General, owned by a sand-and-gravel excavation business, west of Rt. 113 and on the river's north side. This one exception to the Agricultural-Conservation zoning is shown by cross-hatching in Fig. 16. A conditional use permit for operation of a borrow pit for sand-and-gravel excavation was granted by Kent County Levy Court in January, 1990, for the upland area of the 265-acre parcel adjacent to the eastern side of the Industrial-General property. Another borrow pit application for a property west of Rt. 113 but on the south side of the river was not approved by the County last January. All future requests for borrow pit operations in Kent County have been suspended from consideration until the County formulates and implements new regulations for the siting and operation of borrow pits.

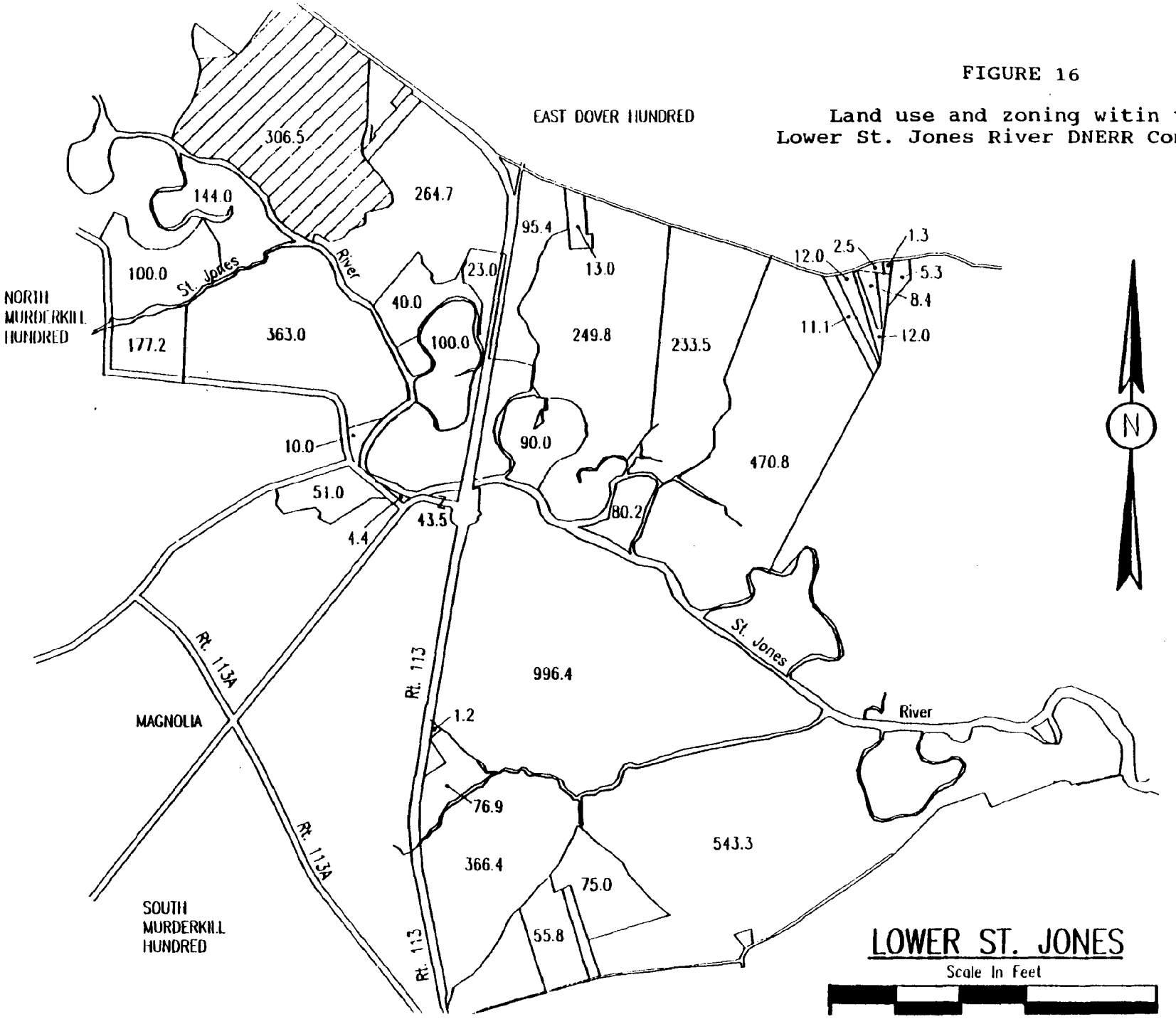
The two borror pit operations will be completely outside of the maximum boundaries identified for the St. Jones component. Only the Wetlands portions of the Industrial-General zoned parcels have been considered for inclusion in the Reserve.

Two considerations that have been addressed for the Lower St. Jones River area are flight paths and noise levels of aircraft taking-off or landing at Dover Air Force Base. Only a very small portion of the proposed DNERR component's buffer area is within the "Accident Potential Area" identified by the Base, and all of this area within the proposed component is west of Rt. 113. An upland area within the Reserve boundaries east of Rt. 113 is the most probable location for a visitors center and support facilities, and is not within a "High Noise Area" (greater than 75 db) as identified by the Base, although a portion of this location may be in a lower "Noise Level Area" (70-75 db). However, this identification as a lower "Noise Level Area" is not uncommon for much of the residential areas of Dover.

The predominance of the Agricultural-Conservation zoning over several thousand acres of the proposed component, with the agricultural flavor that this imparts throughout the lower St. Jones River basin, in conjunction with consideration of air traffic patterns from Dover Air Force Base in terms of facilities sitings, should be conducive to and permit operation of a NERRS program in the Lower St. Jones River estuary.

FIGURE 16

Land use and zoning witin the
Lower St. Jones River DNERR Component



UPPER BLACKBIRD CREEK

A. BLACKBIRD COMPONENT PHYSICAL ENVIRONMENT

1. Climate

The Blackbird Creek component has a humid, continental climate that is modified by the Ocean and Bays. The component is only 20 miles north and along the Delaware Bay coast from the St. Jones component and experiences similar climatic conditions as that described for the St. Jones.

2. Hydrology

Much of the upper Blackbird Creek is tidally influenced. The mean tidal amplitude at Taylors Bridge is almost 3 feet (U.S. Dept. of Commerce, 1989). The most landward reaches of this upper segment are non-tidal. Typical creek widths within the upper creek range from 150 to 200 feet in the tidal section, to only several feet wide in the non-tidal areas nearer the headwaters. Salinities range from 0 ppt (freshwater) in the headwater areas to as high as 7 ppt at the lower end of the Reserve at Taylors Bridge (salinities at the mouth of Blackbird Creek connecting to Delaware Bay may go as high as 10 ppt). Water depths in Upper Blackbird Creek range from over 15 feet deep in the center channel at high tide near Taylors Bridge, to less than two feet in the upstream center channel at low tide. The upper Blackbird Creek is often characterized by wide mudflats in the creek corridor at low tide. Emergent intertidal wetlands dominate the areas along the tidal section of the creek. Wetlands edges along the non-tidal section of Blackbird Creek are dominated by palustrine forested wetlands.

The entire Blackbird Creek watershed has a drainage area of about 20,000 acres. Fifty-one percent of the basin is considered agriculture, 1% urban, and 48% "other" land uses (mainly forested). Basic water quality within the Blackbird Creek system is considered good. Bacteria levels are, however, sometimes considered excessive, apparently due to non-point sources (DNREC, 1988). Nitrogen and phosphorous are considered to be present at low to moderate levels.

The Upper Blackbird Creek is a relatively undisturbed section of a large, tidal wetlands system fringed by oak-beech-maple forest and open farmland. Waters of the proposed Reserve vary in salinity from 0 ppt at the inland extreme to 7 ppt at the seaward end at high tide during low rainfall periods.

3. Geology

The Blackbird component is within the Coastal Plain Province approximately 25 miles south of the Appalachian Piedmont fall Zone and displays essentially the same geological characteristics as that described previously for the St. Jones.

4. Topography

The Upper Blackbird Creek watershed slopes gently upward and westward from the Delaware Bay to the Chesapeake Bay watershed at a high of 82 feet creating a gradient of 16 feet per mile over the length of the 5 mile watershed. At the reserve component the elevation varies from 0 to as much as 57 feet in as little as a quarter mile with gently rolling slopes for approximately 2 miles to the extent of the watershed.

B. BLACKBIRD COMPONENT BIOLOGICAL ENVIRONMENT

1. Flora

The wetlands vegetation of the Upper Blackbird Creek estuary is characterized by two major zones as classified in An Atlas of Delaware's Wetlands and Estuarine Resources (Daiber et al, 1976). Zone I covers the easternmost seaward quarter of the component. This zone, known as the saltmarsh cordgrass marsh, is dominated by saltmarsh cordgrass (Spartina alterniflora). This stout, erect grass occurs as a tall-form near the water's edge, with a smaller dwarf-form behind it extending to the level of mean high water. Some fringes of this zone have common reed (Phragmites australis). Other associated species found at slightly higher elevations are saltmeadow cordgrass (Spartina patens), big cordgrass (Spartina cynosuroides), salt grass (Distichlis spicata), salt wort (Salicornia spp.), high tide bush (Iva frutescens), and groundsel bush (Baccharis halimifolia).

Most of the lower Blackbird Creek estuary has been overrun by phragmites, forming a dense, monotypic cover over vast expanses of wetlands. This incursion has also occurred upstream into some of the more seaward portions of the proposed Reserve component.

The upper landward 3/4 of the component is characterized by the highly diverse Zone V transition marsh. No single species dominates this transition zone; it is a varied mixture of species grading from the cordgrass marsh to a freshwater marsh. Species found in this zone are saltmarsh cordgrass, big cordgrass, common reed, marsh mallow (Hibiscus palustris), three-squares (Scirpus spp.), cattails, (Typha spp.), wild rice (Zizania aquatica), arrow-arum (Peltandra virginica), pickerel weed (Pontederia cordata), and salt-marsh water hemp (Acnida cannabina). This area often has extensive mudflat habitats exposed within the creek corridor at low tide.

The upland fringe included in the component is a mixture of shrub and tree species. Typical of this area are white oak (Quercus alba), southern red oak (Quercus falcata), post oak (Quercus stellata), loblolly pine (Pinus taeda), red maple (Acer rubrum), sweet gum (Liquidambar styraciflua), American holly (Ilex opaca), black cherry (Prunus serotina), sassafras (Sassafras albidum), flowering dogwood (Cornus florida), tulip poplar (Liriodendron tulipifera), arrowwood (Viburnum spp.), and

blackberry (Rubus spp.).

The wetlands types of the Upper Blackbird Creek according to the USFWS's classification scheme (National Wetlands Inventory) are given in Fig. 17.

While not part of the proposed Reserve, the non-estuarine wetlands west of Rt. 13, further upstream of the Reserve, are interesting habitats for study, particularly in terms of their unique biotic assemblages and their unknown interactions with downstream, estuarine areas. Much of this non-tidal palustrine wetlands habitat is found in Blackbird State Forest and in other forested areas south of Townsend, all within about 5 miles from the center of the proposed Reserve. While most of the wetlands of this area are dominated by maple-gum associations, there are dozens of Delmarva Bays scattered throughout this region. These topographic swales or depressions, none larger than a few acres, are wetlands unique in terms of their geology, hydrology, and biota.

2. Fauna

Its isolation from human disturbance, diverse freshwater food plants, and abundant aquatic invertebrate populations make it an attractive waterfowl breeding area. Black duck, mallard and wood duck are among the most common nesting species. During the spring and fall migration periods, extensive use is made of the area by most waterfowl in the mid-Atlantic region, including Canada geese, greenwinged teal, bluewinged teal, gadwall, pintail, wigeon and shoveler. Because of the habitat's particular importance to black duck, its protection from further degradation will help to maintain a species of special concern. Wading birds, shorebirds, and raptors also frequent the area for breeding, migration, feeding and resting. The most common species include great blue heron, great egret, snowy egret, glossy ibis, yellowlegs, sandpipers, kestrels, marsh hawk, osprey and bald eagle. During a site selection field trip in April, 1990 to the Upper Blackbird Creek, a pair of bald eagles was seen perched in a tall tree on an island in the middle of the proposed Reserve. Because of the inland location from the open tide marsh, use by most wading birds and shorebirds may be limited, but the extent of use of the broad mudflats at low tide is unknown at present. The area is probably of high importance to raptors because of its remote location and abundant prey populations. Numerous species of passerine birds also utilize both the wetlands and surrounding forest for food, cover and nesting.

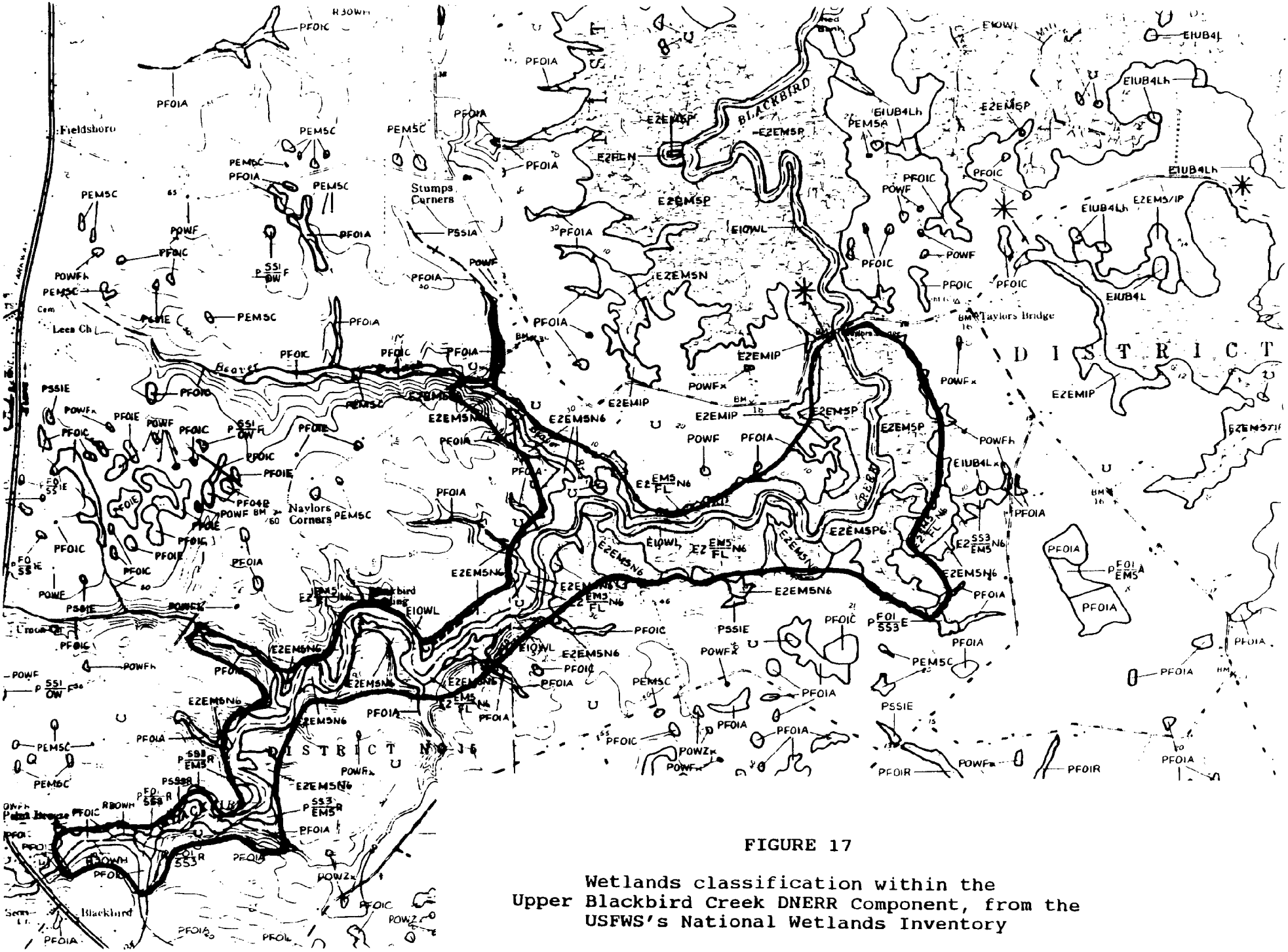


FIGURE 17

Wetlands classification within the Upper Blackbird Creek DNERR Component, from the USFWS's National Wetlands Inventory

Almost all mammals common in Delaware are found in the wetlands and wooded fringe of this component. The forests support deer, fox, raccoon, skunk, opossum, rabbit and squirrel, while large numbers of muskrat occur in the brackish and freshwater wetlands, together with beaver and river otter in lesser numbers. Trapping of furbearers, and waterfowl and deer hunting, are popular activities that annually remove a harvestable surplus. An excellent opportunity to view and photograph wildlife is afforded by a canoe trip down this very beautiful waterway.

The Blackbird Creek estuary provides important nursery and feeding habitat for several species of fish including white and channel catfish, weakfish, hogchoker, white perch, black drum, bay anchovy, menhaden, spot and eels, together with a diversity of benthic organisms including blue crabs. Sport fishing is also a popular activity at this component for species such as white perch, carp, yellow perch, and catfish. In the more landward recesses of the Reserve, where the waters are essentially fresh, the following fish species are frequently encountered: American eel, eastern mudminnow, redfin pickerel, golden and spottail shiners, creek chubsucker, pirate perch, brown bullhead, white and channel catfishes, yellow perch, white perch, pumpkinseed and bluegill sunfishes, and tesselated darter. These fish populations and waterfowl both make use of numerous aquatic insects found here, including members of the families Corixidae, Notonectidae, Dyticidae, Gyrinidae, Gerridae, and Chironomidae. Numerous snakes, turtles, frogs and toads, and salamanders are resident of the component, utilizing both aquatic and terrestrial environments.

The Upper Blackbird Creek component represents a tidal brackish and freshwater habitat differing in estuarine plant and animal communities from the Lower St. Jones River component. As such, it offers unique and specialized opportunities for research, education, recreation and management. Its inclusion in the Delaware NERR System ensures representation of a broad group of estuarine habitats ranging from fresh to saline.

C. BLACKBIRD PREHISTORIC AND HISTORIC RESOURCES

The Upper Blackbird Creek DNERR component spans the interface between two environmental zones of importance in prehistoric settlement systems. Both the mid-drainage and coastal zones provided favorable settings for large and small settlements, and the diversity of floral and faunal species where these two zones come together provides a particularly rich resource base for hunting and gathering peoples. Sites in this area provide an opportunity to study human adaptation to a developing estuarine environment over more than 8,000 years. In the mid-drainage section of the study area, there is a medium probability of base camps and procurement sites from the Archaic Period (6500 B.C. to 3000 B.C.) and the Woodland II Period (A.D. 1000 to A.D. 1600).

There is also a high probability for the entire range of Woodland I Period (3000 B.C. to A.D. 1000) sites. For the coastal segment, there is a medium probability of Archaic procurement sites and a medium to high probability of Woodland I and Woodland II base camps and procurement sites.

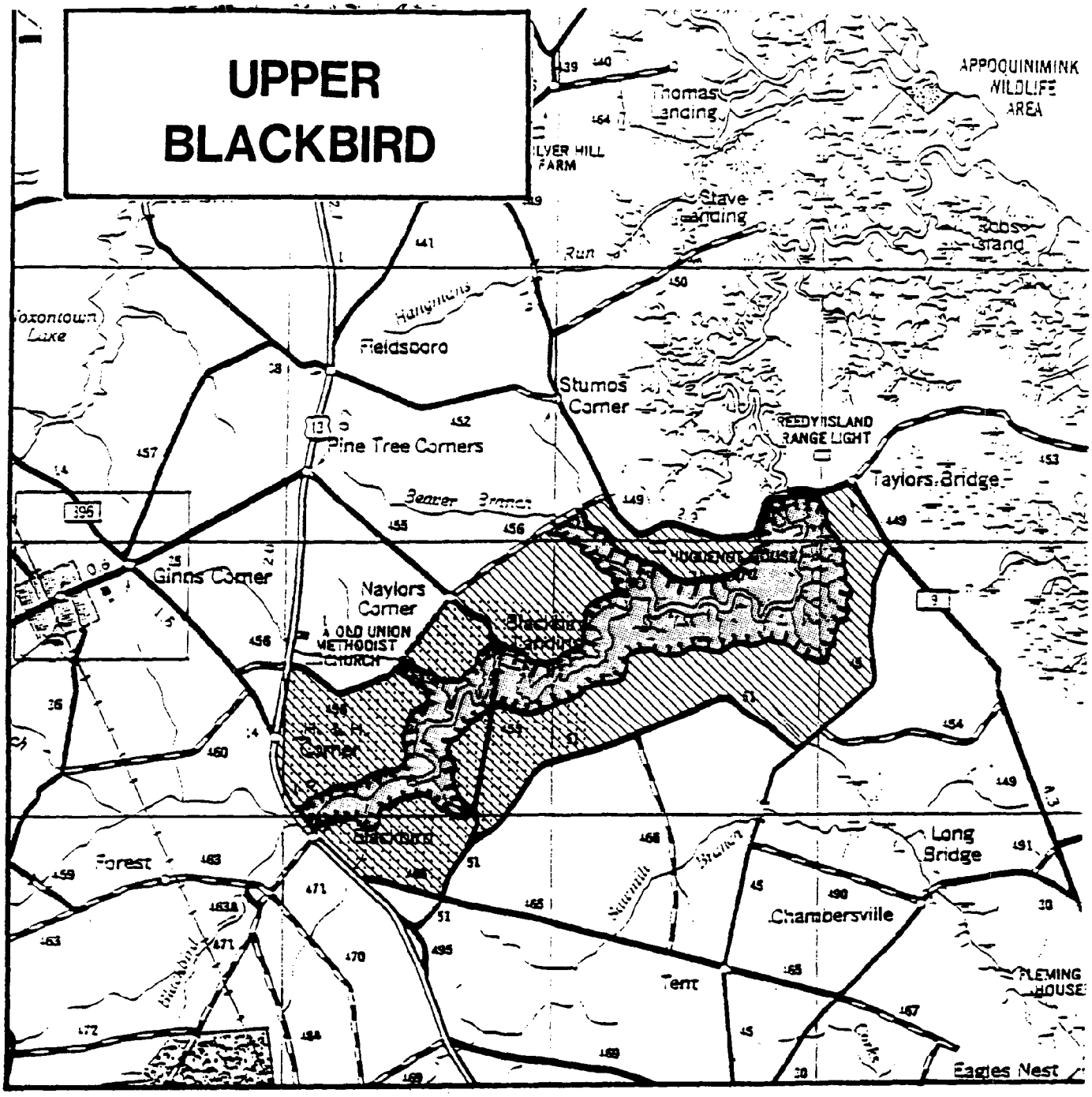
A total of 73 prehistoric archaeological sites in the upland areas adjoining the Upper Blackbird Creek DNERR component have been reported in the Cultural Resource Survey maintained by the Delaware Bureau of Archaeology and Historic Preservation. The western half of this upland area (Fig. 18) has been subjected to reconnaissance level survey for archaeological sites by the University of Delaware Center for Archaeological Research (UDCAR) as part of a planning study conducted for the Delaware Department of Transportation (DelDOT) (Custer and Bachman 1986). The eastern half of the upland area was surveyed by the Delaware Department of Natural Resources and Environmental Control (DNREC) in order to provide a more complete cultural resources inventory for the Upper Blackbird Creek DNERR component.

Fieldwork methods for both surveys relied extensively on surface survey techniques, although there are certain differences which must be kept in mind in comparing the results of the two surveys. In the UDCAR survey, the surface survey techniques were more controlled, and designed to determine the extent of sites as well as their presence. Furthermore, subsurface testing was used in areas where surface visibility was limited. This means that the site inventory is probably somewhat more complete for the western half of the study area. On the other hand, there were very few areas in the eastern part of the study area which would require subsurface testing to identify sites.

Although the boundary between the UDCAR survey and the DNREC was arbitrarily defined by the requirements of the DelDOT planning study, it also coincides with a change in topography. From west to east, the character of the stream valley changes from a narrow floodplain with steep boundaries to a broad marsh with more gradual upland edges beginning at the confluence of Blackbird Creek with Beaver Branch. East of the boundary, there are few landforms which extend above the 50 ft. contour interval, while to the west topographic highs above 50 ft. are common. Bay/basin features are more common west of the boundary between the two studies. These differences are reflected in differences in the frequency and character of sites in the two survey areas. Six of the nine base camps in the UDCAR survey are found on landforms above the 50 foot contour interval and are adjacent to bay/basin features. East of the confluence with Beaver Branch there are few landforms above 50 feet and all six of the base camps in the DNREC survey are situated on ridges between the 10 and 30 foot contours bordering the floodplain.

FIGURE 18

Historical and Cultural characteristics of the
Upper Blackbird Creek DNERR Component



- UPPER BLACKBIRD SITE
- ADJACENT UPLANDS
- DOT SURVEY AREA

In their analysis of the DelDOT study, Custer and Bachman (1986:130, 146) identified an extensive pattern of prehistoric use of bay/basin features as food provisioning and procurement sites. These closed hydrologic features were found to be especially prevalent on broad nearly level ridges from Blackbird Landing west to the headwaters of Blackbird Creek. Nearly 90 percent of the surveyed bay/basin features in the Blackbird segment of the UDCAR survey were associated with prehistoric materials and virtually all of them were exploited during the Woodland I time period (Custer and Bachman 1986:48,136).

The UDCAR survey identified 59 of the 73 sites identified within the DNERR study area. Fifty of these sites were small procurement stations containing a few flakes or broken and discarded tools. Nine sites were identified as base camps, which are found in settings where food resources are highly predictable during certain parts of the year. These sites are generally larger in size and in the concentration and diversity of artifacts than procurement sites. Base camps were further differentiated on the basis of size and the available resource acquisition area into micro-band and macro-band base camps when possible.

One of these base camps was occupied during the Archaic Period, from about 6500 to 3000 B. C., as indicated by the presence of bifurcate projectile points. Woodland I sites are identified by the presence of a variety of stemmed projectile point styles. Sites occupied during the latest of the prehistoric temporal periods, the Woodland II Period, are identified by the presence of triangular points. Ceramic styles are often more sensitive to patterns of temporal change, but none were found during the survey and they seem to be relatively rare for Upper Blackbird Creek as a whole (Custer and Bachman 1986:Table 2, Plate 6). Three base camps identified in the UDCAR survey had both Woodland I and II components, three base camps produced diagnostic Woodland I types of artifacts, and two base camps produced no diagnostic artifacts. In the DNREC survey, one site was identified as a Woodland II base camp, and four other base camps could be assigned to the Woodland I Period. A sixth base camp could not be clearly assigned to any prehistoric period, but was probably occupied at least during the Woodland I Period. Of the 56 procurement sites identified in the project area, only 5 produced diagnostic artifacts (Custer and Bachman 1986, App VII): one was multi-component, one was from the Woodland II period, and three were from the Woodland I period.

In summary, the Blackbird Creek uplands and stream courses were intensively exploited by Woodland I hunting and gathering groups in the period from 3000 B.C. to A.D. 1000. The large number of bay/basin features in proximity to the interface between mid-drainage and coastal settings favored the establishment of sites of large size and permanence at the convergence of these zones. Changes in settlement patterns by Woodland II (A.D. 1000 to A.D. 1650) times focused food acquisition strategies primarily on the estuarine resources in

the floodplain rather than the uplands (Custer and Bachman 1986:128, 144, 150). Both the number of sites and the size of sites decreases during the Woodland II period in the High Coastal Plain physiographic province, of which Blackbird Creek is a part.

Nothing is known about the Contact Period in the Upper Blackbird area. This period spans the time from the first contact of Native Americans on the Delmarva Peninsula with Europeans (about 1600) to their disappearance as recognizable tribal groups in the first half of the 18th century. This area has been identified as a focus of European settlement in the 17th century, although no sites from this time period have been identified in archaeological collections. The earliest historic period settlement in the study area is represented by the Huguenot House, which is listed on the National Register of Historic Places. This house was built early in the first quarter of the 18th century, and was expanded by the second generation of owners. It is significant as an example of the prosperous farmer's residence of pre-revolutionary Delaware. The house and much of its surrounding acreage was purchased in early 1990 by Holger H. Harvey, who was instrumental in the State's acquisition (with State funds) for the DNERR program of a key parcel of wetlands having an associated upland buffer/access strip, both of which were partitioned from the tract previously forming the Huguenot House property bought by Mr. Harvey. The remaining standing structures in the area adjacent to the Upper Blackbird Creek component are agricultural complexes dating primarily to the 19th century. Reconnaissance level survey for this area is complete, although it is possible that some structures dating after 1860 were not recorded.

D. BLACKBIRD ZONING AND LAND USE

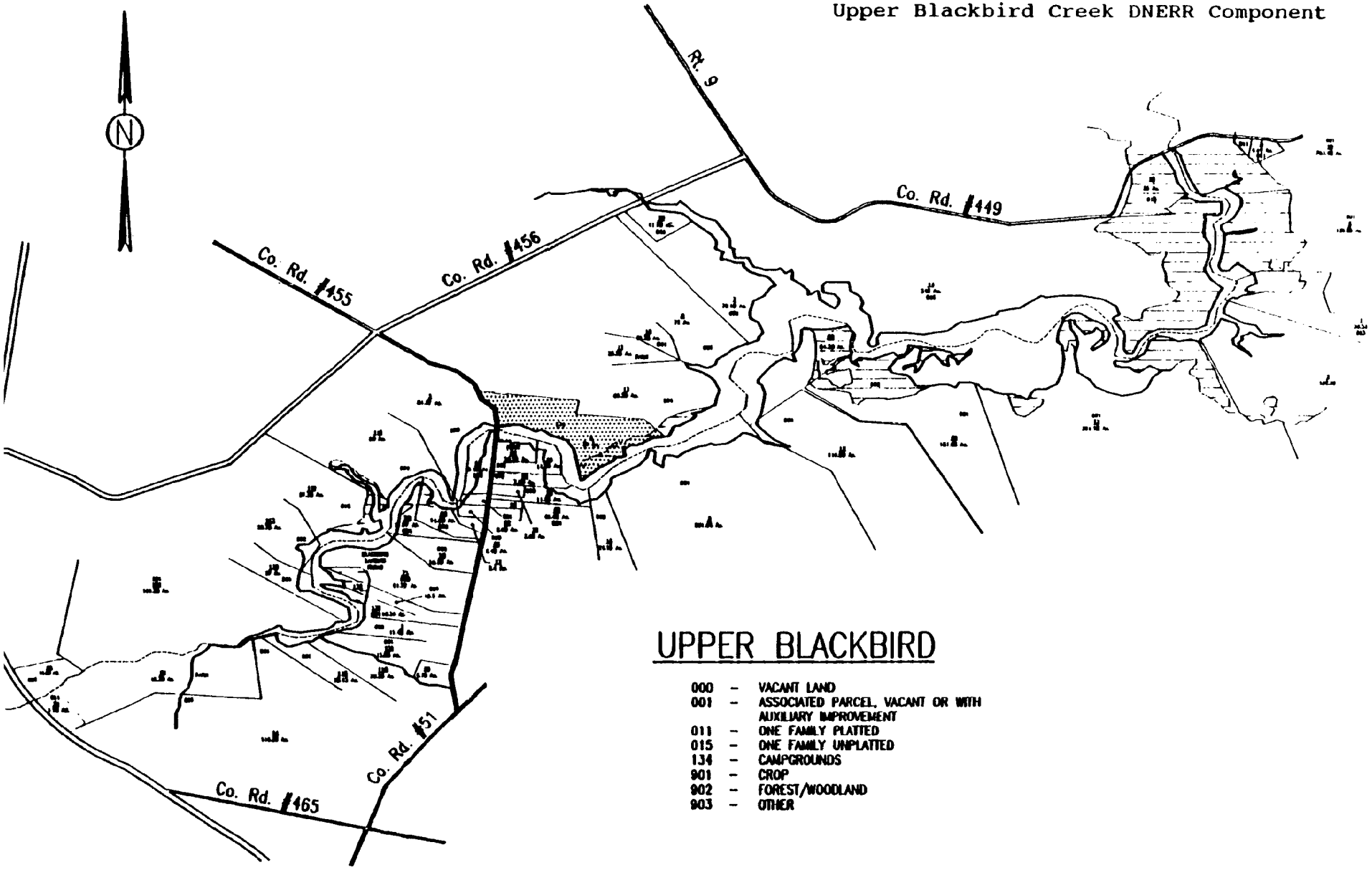
All of the properties within the proposed Upper Blackbird Creek component and the surrounding properties are within a county agricultural district, and the zonings are either for farming or single family residential use (Fig. 19). None of the present uses appear to be detrimental or adverse to the proposed operation of a DNERR component. Land use codes on Fig. 16 range from vacant lots to campgrounds to cropland as follows:

000 - Vacant Land
001 - Associated Parcel, Vacant or with Auxiliary Improvement
011 - One Family Platted
015 - One Family Unplatted
134 - Campgrounds
901 - Crop
902 - Forest/Woodland
903 - Other

The Upper Blackbird Creek area is only about 26 miles from downtown Wilmington. This area, like much of southern New Castle County below the Chesapeake and Delaware Canal, is either

FIGURE 19

Land use and zoning within the
Upper Blackbird Creek DNERR Component



undergoing rapid residential development or is on the verge of doing such. With the completion of the "Rt. 13 Relief Route," which will be built over the next several years, the rate of development of southern New Castle County will accelerate even faster, with the area serving essentially as a "bedroom community" for urban workers commuting to Wilmington, Newark or other urban centers. The DNERR can help to guide and lessen the environmental impacts of this inevitable development for lands around the Blackbird Creek watershed.

The planned route of the Rt. 13 Relief Route will affect the most landward portion of the Upper Blackbird Creek DNERR component. The Relief Route where it crosses Upper Blackbird Creek will do so at a location about 1000 feet to the east of the present location of Rt. 13. Since the upper end of the proposed Reserve is at Rt. 13, the Relief Route will be placed 1000 feet inside the proposed boundaries of the Reserve. Discussions with the Delaware Department of Transportation (Division of Highways) indicate that most of the evironmental impacts will occur during construction, and all steps will be taken to minimize detrimental impacts. The engineering design of the Relief Route where it passes over the upper Blackbird Creek corridor will be done in such a manner that minimum permanent loss of wetlands occurs. Essentially, when the Relief Route is completed, the environmental ambiance now associated with Rt. 13 will have moved about 1000 feet to the east. In a proposed Reserve river corridor of 5.7 miles, about 3.3% of the corridor would have been encroached, but the type of upstream habitat altered by the new route is still well represented throughout a ouple of miles downstream from the project.

In order to provide a positive benefit to the Upper Blackbird Creek DNERR component, the Delaware Division of Highways was receptive to the idea of creating a canoe access site for the Reserve in conjunction with the Relief Route. This might be done at the uppermost end of the proposed Reserve, on the east side of the present location of Rt. 13. This would greatly help provide an appropriate type of water access to upper Blackbird Creek. Water access throughout the proposed Reserve is limited, so it will also be necessary to explore creation of an access point for motorized small boats, perhaps at Blackbird Landing, Taylors Bridge or another location. The Division of Highways might also be of assistance with this effort.

XVIII. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED DNERR

A. GENERAL

Establishment of the proposed Delaware National Estuarine Research Reserve will have a net positive impact on both the natural environment and the human environment.

Negative impacts of the construction of the Estuarine Education and Research Center and associated public access facilities will be minimized by proper and informed site selection and construction details under the highest regard for the natural environment.

The primary impact on the natural environment will be long-term protection of the natural resources of the Reserve, such as the natural biota and their habitats. This is an obvious positive impact. Impacts of the education and research programs will be positive because they will supply information which will lead to better management of estuarine resources. Impacts on water quality will be positive in the buffered core areas and positive to negligible in other areas.

Impacts on the human environment include mostly positive impacts. Scientific and educational benefits will be positive. Traditional uses of the Reserve's land and water areas will not be hampered, and may be enhanced. Effects on employment will be negligible. Minor negative fiscal impacts may occur due to decreased tax revenues. Infrastructure impacts will be minor. Aesthetic impacts will be positive. Cultural resources are protected by the management plan with most impacts being positive with some construction impacts being mitigated.

B. SPECIFIC IMPACTS

1. Construction

The construction of the Education and Research Center along the St. Jones River will take place on a small area of existing cleared upland with the most sensitivity to the adjacent wetlands and woodland fringe. The location of the Center is between two airforce approach runways, however not within accident potential zones or high noise areas. Other construction (such as construction of boardwalks, trails, docks, observation decks, or parking lots) may take place over a broader area of the Reserve, but will be minor and unobtrusive and will cause minimal disturbance. Overall impacts from construction will be negligible. Necessary permits and agency approvals will be obtained with the intent to demonstrate the best methods to reduce potential negative impacts.

2. Visitor Use

Visitor use is expected to increase due to the formation of the Reserve. The proposed action will result in more visitors for education and to a lesser degree research and allowed traditional uses. Designation may decrease the number of illegal activities in the two components.

The John Dickinson Mansion and visitors barn planned expansion for DNERR is expected to receive the walk-in visitors. The visitors barn is on a controlled ten acre site operated by the State Bureau of Museums and Historic Sites.

The anticipated visitors to the Reserve due to the newly formed Education and Research Programs will not cause significant negative impacts on the natural environment because: 1) these visitors will be directed away from sensitive areas of the Reserve; 2) groups of visitors will be well supervised; and 3) these visitors will be oriented to the fragility of the Reserve's resources before use. The designation of the Reserve should not affect the number of visitors for traditional legal activities, such as hunting and fishing. Designation may have a positive impact by decreasing poaching, littering, vandalism, driving of off-road vehicles, and other harmful activities in the Reserve. These activities may decrease due to: 1) education of the local communities about the fragility of estuarine systems and the purpose of the Reserve; and 2) the presence of staff, researchers, and education visitors on the sites.

Public access policies will be developed, implemented and enforced. These restricted access policies will serve to control visitor use. Any environmental effects of visitors to the Reserve will be carefully monitored. The carrying capacity for visitor use at each component will be determined. Exceeding the carrying capacity could have significant negative impacts on the natural and human environment of a site. Visitor use will be monitored and access policies will be enforced so that the carrying capacity will not be exceeded. Only visitor use which has minimal effects on the environment will be permitted.

3. Impacts on the Natural Environment

a. Wetlands, Uplands and Open Water/Habitat

Establishment of the proposed DNERR would ensure long-term protection of the wetland, open water, and upland areas which are the productive habitats of diverse flora and fauna populations. This will have significant positive impacts on these habitats.

Education and research programs will have a net positive effect on habitats. The programs will be managed so as to cause minimal disturbance to the environment. They will increase knowledge and understanding of estuarine systems leading to improved care and management of these valuable habitats.

As previously detailed, construction and visitor use will have negligible effects.

b. Biota

The long-term protection of habitats ensured by designation of the proposed DNERR will serve to benefit the natural biota. Monitoring of rare and endangered species may lead to State or national protection measures which will benefit these species. Government regulations and owner policies dealing with the harvesting of natural resources (e.g. hunting, fishing, and zoning regulations) will not be changed by designation. Overall the impact on the biota will be positive.

c. Water Quality

Impacts on water quality will be positive in some areas and negligible in others. Protection of the wetlands in the Reserve ensures the continued buffering action of wetlands. Protected wetlands will help to maintain or improve water quality by decreasing sediment, nutrient and chemical loads in open water areas. Updating and improving conservation plans, including Best Management Practices (BMP's) for non-point sources of pollution, on buffer areas will also improve water quality. The plans for an on site waste disposal system for the DNERR Education and Research Center will be carefully reviewed to ensure that the effects of the system on water quality are negligible. Water quality monitoring will be a major part of the research and monitoring programs of the Reserve. This monitoring may lead to better management practices in the future which should continue to improve water quality.

5. Impacts on the Human Environment

a. Scientific and Educational

Designation of the Reserve will make a valuable resource, protected field laboratories, available on a long-term basis to local public and private research organizations and institutions. Education programs will benefit the State and region by providing opportunities for groups and individual citizens to increase their awareness, understanding of estuarine systems and participation in the protection of them. Sound, informed coastal management decisions resulting from dissemination of research results to coastal managers and users will benefit the local community, the State, the region, and the nation.

b. Traditional Uses

The establishment of the proposed estuarine Reserve will not restrict traditional uses of the environment and it may enhance these uses. For example , improved water quality resulting from protection of the Reserve may enhance fishing activities.

Designation will also provide long-term assurance that natural resources and benefits of the area will be available for future use and enjoyment.

c. Employment

No jobs will be eliminated by the designation of the Reserve. A few permanent full or part-time jobs may be created, such as the estuarine educator, realty specialist, aquatic educator, and other on-site staff. Temporary employment will be provided during the construction of the DNERR Center and other facilities. Overall effects on employment of the local community are negligible.

d. Public Participation

Designation of the Reserve creates excellent opportunities for local citizens to become aware of and involved in decisions and programs affecting the Delaware Bay and other estuaries of the Mid-Atlantic region. Volunteers, students, and advisory committee members gain greater understanding of estuarine systems, the problems facing them, and policies and programs designed to help them. In return, they provide valuable new ideas and solutions and provide the time and energy to implement some of them. The Reserve programs will provide citizens with the opportunity to gain tremendous satisfaction and gratification by contributing individual knowledge and talents to the collective effort of understanding and protecting our precious estuaries.

e. Fiscal

The existence of a National Estuarine Research Reserve in a community could have positive impacts on the value of lands abutting the sites. As the amenities of the estuary are preserved, the adjacent properties may become more desirable and valuable.

The designation of DNERR may cause some tax revenue losses as properties are bought and conservation easements are placed on privately owned lands.

f. Infrastructure: Public Roads and Parking Areas, Potable Water Supplies, Sewer Systems, and Energy Supplies

The construction of a public access road, parking lots, water well, on-site sewer system, electric and telephone lines will need to be provided to the Education and Research Center. Although the Center will be only six miles from the urban center of the State Capitol, its proposed site is nearly one mile from the nearest public road, telephone and electric services. All infrastructure listed above is proposed to take place on currently cleared upland areas which will cause the minimum negative impacts to the surrounding environment.

g. Aesthetic

Designation of the Reserve will protect the existing natural beauty of the lower St. Jones River and the upper Blackbird Creek, and will make this beauty more available to the surrounding communities through public access. The St. Jones River, from the Bay through the City of Dover, has been nominated as a State model greenway. Reserve interpretation and education programs will enhance the public's awareness and appreciation of the aesthetic as well as the practical values of estuaries. Many education activities will use a multisensory approach, helping people to gain familiarity with and enjoy the resources of the estuary through seeing, hearing, smelling and feeling. Passive enjoyment activities, such as watching and listening to birds or sketching estuarine scenes, will be encouraged. Designation will have a significant positive impact on aesthetics.

h. Cultural Resources

Cultural resources such as historical and archaeological sites and artifacts will be protected and enhanced. These resources will also be made more available to the public through education programs. Designation of the Reserve will have a significant positive impact on cultural resources.

i. Public Access

Public access for educational, observational and other passive activities will be promoted through the construction of the DNERR Center, trails, boardwalks, and observation points and the provision of boats for education and research programs. However, access to the Reserve will be monitored and controlled and access policies will be implemented and enforced. Designation will have a positive effect on public access.

C. Irreversible or Irretrievable Commitment of Resources

No resources will be irreversibly or irretrievably lost. On the contrary, designation of the proposed DNERR will provide long-term protection of their natural and cultural resources.

D. Possible Conflicts Between the Proposed Action and the Objectives of Federal, State, Regional and Local Land Use Plans, Policies, and Controls for the Area Concerned

The establishment of the proposed DNERR will not be in conflict with the objectives of federal, state, regional, or local land use plans, policies, and controls. The proposed action is consistent with all relevant regulations. The Reserve will cooperate with all federal, state, and local agencies whose jurisdictions affect the proposed DNERR sites and comply with their regulations. All necessary permits and agency approval will be obtained for Reserve construction and other activities. The proposed Reserve is crossed by flight tracks of the Dover Air

Force Base. However, the development of the Center and operations of the Reserve is consistent with the Base's Air Installation Compatible Use Zone study especially concerning accident potential zones and noise level areas. The Reserve's intent is to preserve the habitats, not increase attractions for birds that could cause problems with aircraft engines, therefore consistent with the policies of the Department of the Air Force.

Local Activities Which May Effect Sites

The U.S. Route 13 relief route has the largest potential for effecting areas immediately adjacent to the Reserve boundaries. There are 3 primary activities associated with the relief route that will need to be monitored closely: 1) The construction of the highway adjacent to the upper reaches of the Blackbird Creek component; 2) The existing and potential sand and gravel borrow pit operations adjacent to the upper reaches of the St. Jones River component; and 3) The potential commercial and residential development that accesses to the controlled highway planned near the proposed Reserve's components could have on the DNERR programs. The defined boundary alternatives considered these potential conflicts, therefore boundaries are located and include buffer areas adequate to preserve the integrity of the key land and waters for their long term research and education values.

The DNERR management plan clearly emphasizes coordination and cooperation with existing local, state, regional, and federal estuarine programs and with local and state education systems.

XIX. ACKNOWLEDGEMENTS

A. DNERR WORKING COMMITTEE

David S. Hugg III	Office of the Secretary, DNREC
Lee Emmons	Office of the Secretary, DNREC
William Meredith	Division of Fish and Wildlife, DNREC
James O'Neill	Division of Parks and Recreation, DNREC
Joan Brown	Division of Parks and Recreation, DNREC
Ron Vickers	Division of Parks and Recreation, DNREC
Cara Blume	Division of Parks and Recreation, DNREC
David Saveikis	Division of Water Resources, DNREC
Tony Pratt	Division of Soil and Water Cons., DNREC
Shirley Bowden	Delaware Assosiation of Cons. Districts
Daniel Griffith	Delaware Div.of Hist. and Cult. Affairs
Cheryl Graham	NOAA/SRD/NERRS

B. SUPPORT SERVICES

Deborah Bell	Division of Parks and Recreation, DNREC
Aren Wright	Division of Parks and Recreation, DNREC
Georgia Vaughan	Division of Parks and Recreation, DNREC
Maryellen Brown	Management and Operations, DNREC
Ella Hand	Division of Fish and Wildlife, DNREC
Field Personnel (boat use)	Division of Fish and Wildlife, DNREC

C. CONSERVATION DISTRICT ASSISTANCE

Fredrick T. Mott	Delaware Association of Conservation Districts
Josef A. Burger	New Castle Conservation District
Ernest Zimmerman	Kent Conservation District

D. DNERR ADVISORY COMMITTEE MEMBERS

Joseph Abele	New Castle County
Grover Biddle	Delaware Development Office
Cara Blume	Division of Parks & Recreation, DNREC
Paul Bradley	Blackbird DNERR Landowners Assoc.
Howard Brokaw	Delmarva Ornithological Society
Joan Brown	Division of Parks & Recreation, DNREC
Jack Cairns	Delaware Dept. of Public Instruction
John Campanelli	Delaware Wildlife Federation
Rick Cole	Division of Fish and Wildlife, DNREC
Richard Cooch	New Castle Historical Society
Elesa Cottrell	U.S. Soil Conservation Service
Ed Cregar	City of Dover
Franklin C. Daiber	Advisory Council-Tidal Finfish
Paul Daly	Bombay Hook National Wildlife Refuge
E. Turner Darden	Delaware Sierra Club Group
Norman Dill	Delaware State College
Kevin Donnelly	Delaware Dept. of Agriculture
Susan Durden	Sanctuaries & Reserves Division, NOAA
Lee Emmons	Office of the Secretary, DNREC
Bill Fintel	Sussex Bird Club
John L. Gallagher	University of Delaware
James Gawthrop	St. Jones DNERR Landowners Assoc.
Tim Goodger	NOAA, NMFS
Cheryl Graham	Sanctuaries & Reserves Division, NOAA
Dan Griffith	Delaware Div. of Hist. & Cult. Affairs
Kyle Gulbronson	Kent County
William Hall	University of Delaware
Willis Hand	Advisory Council on Shellfish
Holger H. Harvey	Delaware Wild Lands, Inc.
Richard Hassel	U.S. Army Corps of Engineers
Betty Heinold	Blackbird DNERR Landowners Assoc.
Lynn Herman	Division of Fish and Wildlife, DNREC
Terrence L. Higgins	Wesley College
Betty Homan	Daughters of the American Revolution
Bill Hopkins	Division of Parks & Recreation, DNREC
William Hubbard	Delaware Bass Federation
David Hugg III	Office of the Secretary, DNREC
Lisa Innvaer	Division of Fish and Wildlife, DNREC
Larry Irelan	New Castle Conservation District
Tim Kaden	Delaware Forestry Section
Dave Kamison	Advisory Council-Game and Fish
Lawrence Lank	Sussex County
Susan Laporte	Division of Parks & Recreation, DNREC
Joe Lesley	Delaware State Trappers Assoc.
Art Malinoski	Kent Conservation District
Albert Matlack	Society of Natural History of Delaware
Bill Meredith	Division of Fish & Wildlife, DNREC
Rob McKim	The Nature Conservancy
Philip A. Messina, Jr.	Del. Saltwater Sportsmen Assoc.
Jonathan Mick	Delaware Watermen's Assoc.
Roy Miller	Division of Fish and Wildlife, DNREC
Bill Moyer	Division of Water Resources, DNREC

Jim O'Neill	Division of Parks & Recreation, DNREC
Matt Parker	U.S. Air Force
Grace Pierce-Beck	Delaware Audubon Society
Tony Pratt	Division of Soil & Water Cons, DNREC
Gordon Price	Del. Mobile Surf-fishermen, Inc.
Skipper Purnell	Friends of Dickinson Mansion
Francis Remley	Kent County Archaeological Society
Michael E. Riska	Delaware Nature Society
Leah Roedel	Del. River & Bay Shoreline Committee
Chas Salkin	Division of Parks & Recreation, DNREC
George H. Sapna II	Ducks Unlimited - Delaware
Dave Saveikis	Division of Water Resources, DNREC
John Schneider	Division of Water Resources, DNREC
David Small	Office of Information and Ed, DNREC
Jim Stewart	Del. Div. of Hist. & Cult. Affairs
David Truesdale	Blackbird DNERR Landowners Assoc.
Joe Uravitch	Sanctuaries & Reserves Division, NOAA
Ron Vickers	Division of Parks & Recreation, DNREC
William Wagner	Division of Fish and Wildlife, DNREC
Ulysses S. Washington	Delaware State College
Bill Whitman	Division of Fish and Wildlife, DNREC
Alvin Wilson	St. Jones DNERR Landowners Assoc.
Joe Wutka	Division of Highways
Chris Zimmerman	St. Jones DNERR Landowners Assoc.
Robert Zimmerman	Division of Water Resources, DNREC

XX. DISTRIBUTION LIST OF DEIS/DMP

The following is a list of the agencies, organizations, and persons receiving copies of the DEIS/DMP:

Federal Agencies

- Advisory Council of Historic Preservation
- Deparment of Agriculture
- Department of Commerce, National Marine Fisheries Service
- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of Interior, Fish and Wildlife Service
- Department of Justice
- Department of Labor
- Department of Transportation, Coast Guard
- Department of Transportation, Federal Highway Administration
- Environmental Protection Agency
- Federal Energy Regulatory Commission
- General Services Administration
- Nuclear Regulatory Commission

Congressional

- Senator William V. Roth, Jr.
- Senator Joseph R. Biden, Jr.

- Representative Thomas R. Carper

State Officials

- Governor Michael N. Castle

- Senator Nancy W. Cook
- Senator Ruth Ann Minner
- Senator John C. Still III
- Senator William C. Torbert
- Senator James T. Vaughn

- Representative Edward Bennett
- Representative Gerald Buckworth
- Representative George V. Carey
- Representative G. Wallace Caulk, Jr.
- Representative Philip Corrozi
- Representative Bruce Ennis
- Representative E. Stuart
- Representative Roger Roy
- Representative Steven C. Taylor

State Agencies

- Delaware Department of Natural Resources and Environmental Control
  A. Office of the Secretary
  B. Division of Fish and Wildlife
  C. Division of Parks and Recreation
  D. Office of Information and Education
  E. Wetlands Branch
  F. Delaware Estuary Program, Div. of Water Resources
  G. Division of Soil and Water Conservation

- Office of the Governor, Delaware Development Office
- Dept. of State, Div. of Historical and Cultural Affairs
- Delaware Dept. of Agriculture
- Delaware Dept. of Transportation
- Department of Public Instruction

Kent and New Castle County Governments

- Executives, Planning, Parks & Recreation Boards & Departments

- Kent and New Castle Conservation Districts

Local Federal and City Agencies

- Bombay Hook National Wildlife Refuge
- U.S. Soil Conservation Service
- U.S. Army Corps of Engineers, Phila. District
- Dover Air Force Base
- City of Dover, Mayor, Recreation and Planning offices

Academic Community

- Delaware State College
- University of Delaware
- University of Delaware, Sea Grant Program
- University of Delaware, College of Marine Studies
- University of Delaware, College of Agriculture
- Wesley College
- University of Maryland, Eastern Shore

Libraries

- Dover Public Library
- Delaware State Library
- Milford Public Library
- Smyrna Public Library
- Appoquinimink Public Library
- Corbit-Calloway Library
- New Castle Public Library

Other Interest Groups

- Fish and Wildlife Citizen Advisory Councils
  A. Advisory Council on Game and Fish
  B. Advisory Council on Tidal Finfisheries
  C. Advisory Council on Shellfisheries

- Conservation/Environmental Education/Outdoors/Sportsmen Organizations
  A. Wildlife Federation of Delaware
  B. Ducks Unlimited, Inc. (Delaware)
  C. Delaware Saltwater Sportsmen Association
  D. Delaware Mobile Surf-Fishermen, Inc.
  E. Delaware Bass Federation
  F. Delaware Watermen's Assoc.
  G. Delaware State Trappers Assoc.
  H. Delaware Wild Lands, Inc.
  I. Delaware Nature Society
  J. Society of Natural History of Delaware
  K. Delmarva Ornithological Society
  L. Sussex Bird Club
  M. Delaware Audubon Society
  N. Delaware Sierra Club
  O. Delaware River and Bay Shoreline Committee
  P. Delaware Nature Conservancy

- Historical Societies
  A. New Castle Historical Society

B. Kent County Archaeological Society
C. Friends of Dickinson Mansion
D. Daughters of the American Revolution

- DNERR Landowner Associations
  A. St. Jones DNERR
  B. Blackbird DNERR

- DNERR Work Groups
  A. DNERR Facility
  B. Resource Plan Work Group Members

- Chesapeake Bay NERR in Maryland

XVI. BIBLIOGRAPHY

Belknap, D. F. and J. C. Kraft 1977. Holocene relative sea-level changes and coastal stratigraphic units on the northwest flank of the Baltimore Canyon geosyncline. Journal of Sedimentary Petrology 47(2):610-29).

Chabreck, R.A. 1988. Coastal Marshes: Ecology and Wildlife Management. Univ. of Minnesota Press, Minneapolis. 138 pp.

Chura, M. (chairman) 1990. Greenspace for Delaware's Future: Draft for Public Review. Greenspace for Delaware's Future Committee. Delaware Dept. Natural Resources and Environmental Control, Dover. 52 pp.

Crofts, M. (program coordinator) 1989. Fiscal Year 1989 Work Plan for the Delaware Estuary Program. Delaware Dept. Natural Resources and Environmental Control, Dover. 11 pp.

Cunningham, Kevin, J. W. Martin, and J.L. Calvert 1980. A Preliminary Cultural Resources Reconnaissance of the Proposed Dualization of U.S. Route 113 Little Heaven to Dover AFB, Kent County, Delaware. Submitted to Delaware Department of Transportation and Delaware Department of Historical and Cultural Affairs, Dover.

Custer, Jay F. 1983. Analysis of Collections from Three Barker's Landing Sites, Kent County, Delaware. University of Delaware Center for Archaeological Research Report # 3. Newark.

Custer, J.F. and G. J. Galasso. 1983. A prehistoric archaeological survey of the St. Jones and Murderkill drainages, Kent County, Delaware. Bulletin of the Archaeological Society of Delaware 14 New Series. pp. 1-18.

Custer, J.F. and D.C. Bachman. 1986. An archaeological planning survey of selected portions of the proposed Route 13 corridor, New Castle County, Delaware. DelDOT Archaeology Series No. 44. Delaware Department of Transportation.

Custer, Jay F. 1989. Prehistoric Cultures of the Delmarva Peninsula: An Archaeological Study. University of Delaware Press: Newark.

Daiber, F.C. 1986. Conservation of Tidal Marshes. Van Nostrand Reinhold Co., New York. 341 pp.

Daiber, F.C. et al. 1976. An Atlas of Delaware's Wetlands and Estuarine Resources. Delaware Coastal Mgmt. Program, Tech. Rept. No. 2. Delaware State Planning Office. College of Marine Studies, Univ. Delaware. 528 pp.

Delaware Dept. of Natural Resources and Environmental Control. 1989. Annual Report: Non-Game and Endangered Species Program

and Natural Heritage Program. Division of Fish and Wildlife, and Division of Parks and Recreation, DNREC, Dover, Delaware. 21 pp.

Delaware Division of Historical and Cultural Affairs. 1972. Huguenot House National Register Nomination. Dover, Delaware.

Delaware Division of Historical and Cultural Affairs. 1978. Historic Resources of St. Jones Neck National Register Nomination. Dover, Delaware.

Delaware Division of Historical and Cultural Affairs 1978. National Register Nomination for St. Jones Neck Archaeological District. Manuscript on file, Delaware Division of Historical and Cultural Affairs: Dover.

Delaware Division of Parks and Recreation. 1984. Delaware Outdoors: A Comprehensive Plan for Meeting Delaware's Outdoor Recreational Needs and Conserving the Environment. State Comprehensive Outdoor Recreation Plan, Division of Parks and Recreation, Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 128 pp. + appendices.

Delaware Division of Parks and Recreation. 1988. The Landowner's options - A Guide to Voluntary Land Protection in Delaware. Division of parks and Recreation, Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 13 pp.

Delaware Mosquito Control Section. 1989. Mosquito Control in Delaware. Delaware Dept. Natural Resources and Environmental Control. 4 pp. (brochure)

Drew, K.S. 1981. The Influence of Geological Structure and Historical Changes in Morphology Of Delaware Bay Communities on Environmental Planning. College of Marine Studies U of D. Contractor: J.C. Kraft, Department of Geology, University of Delaware, Newark, Delaware.

Eveleigh, T., J.F. Custer, and V. Klemas. 1983. A LANDSAT generated predictive model for prehistoric archaeological sites in Delaware's coastal plain. Bulletin of the Archaeological Society of Delaware 14 New Series. pp. 2038.

Fleming, L.M. 1978. Delaware's Outstanding Natural Areas and Their Preservation. Delaware Nature Education Society, Hockessin, Delaware. 422 pp.

Gelburd, D.E. 1988. The patterning of human behavior: a test of a prehistoric archaeological subsistence and settlement model for Delaware. Unpublished PhD dissertation. American University, Washington, D.C.

Goodrich, D.M. (ed.) 1986. Delaware Bay: Issues, Resources, Status and Management. NOAA Estuary-of-the-Month Seminar Series No. 2. U.S. Dept. of Commerce, NOAA Estuarine Programs Office. Washington, D.C. 149 pp.

Henshaw, F. (ed.) 1988. Delaware Water Quality Inventory. Vol. II. Water Quality Analysis Section. Div. Water Resources, Dept. Natural Resources and Environmental Control, Dover, Delaware. Doc. No. 40-08/88/03/01.

Hugg, D.S. III (program mgr.) 1979. Delaware Coastal Management Program and Final Environmental Impact Statement. Delaware Coastal Management Program, Office of Management, Budget and Planning, Dover, Delaware; Office of Coastal Zone Management, NOAA, U.S. Dept. of Commerce, Washington, D.C.

Hull, C.H.J. and J.G. Titus (eds.) 1986. Greenhouse Effect, Sea Level Rise, and Salinity in the Delaware Estuary. U.S. Environmental Protection Agency and the Delaware River Basin Commission. EPA 230-05-86-010. 88 pp.

Jones, W.L. and W.C. Lehman. 1987. Phragmites control and revegetation following aerial applications of glyphosate in Delaware. In Whitman, W.R. and W.H. Meredith (eds.) Waterfowl and Wetlands Symposium: Proceedings of a Symposium on Waterfowl and Wetlands Management in the Coastal Zone of the Atlantic Flyway. Delaware Coastal Management Program, Delaware Department of Natural Resources and Environmental Control, Dover, Delaware. pp. 184-203.

Knighton, M.D. (ed.) 1985. Water Impoundments for Wildlife: A Habitat Management Workshop. Gen. Tech. Rep. NC-100. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, N. Central Forest Experiment Sta. 136 pp.

Kraft, J.C. 1971. A Guide to the Geology of Delaware's Coastal Environments. College of Marine Studies, Univ. Delaware. Newark, Delaware. 220 pp.

Kraft, J.C., E.A. Allen, D.F. Belknap, C.J. John, and E.M. Maurmeyer. 1976. Delaware's Changing Shoreline. Delaware Coastal Management Program, Tech. Rept. No. 1. Dept. of Geology, Univ. Delaware, Newark, Del. 319 pp.

Martin, C.C. 1974. Delaware's Tidal Streams. Division of Fish and Wildlife, Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 32 pp.

Maryland, State of. 1987. Maryland Chesapeake Bay National Estuarine Research Reserve System: Site Nominations. Maryland Dept. Natural Resources, Annapolis, Md. 208 pp.

Maryland, State of. 1990. Maryland Chesapeake Bay National Estuarine Research Reserve System: Final MANAGEMENT PLAN Maryland Dept. Natural Resources, Annapolis, Md. 111 pp. + appendices.

Matthews, E.D. and O.L. Lavoie. 1970. Soil Survey of New Castle County, Delaware. SCS/USDA. 97 pp.

Matthews, E.D. and W. Ireland, Jr. 1971. Soil Survey of Kent County, Delaware. SCS/USDA. 66 pp.

MDR Associates. 1989. Delaware Estuary Program: Summary of the Workshop - Working Together to Enhance and Preserve the Estuary. Rept. for U.S. Environmental Protection Agency. Baltimore, Md. 11 pp.

Meredith, W.H. (Project Manager) 1990. The Delaware National Estuarine Research Reserve System Site Nomination. Report to NOAA/National Ocean Service. Dept. of Natural Resources and Environmental Control, Dover, Delaware. 174 pp.

Meredith, W.H., D.E. Saveikis, and C.J. Stachecki. 1985. Guidelines for "Open Marsh Water Management" in Delaware's salt marshes: objectives, system designs, and installation procedures. Wetlands (J. Soc. Wetlands Scientists), Vol. 5: 119-133.

New Hampshire, State of. 1989. GREAT BAY NATIONAL ESTUARINE RESEARCH RESERVE MANAGEMENT PLAN. State of New Hampshire, Office of State Planning, Concord, NH. 188 pp.

North Carolina, State of. 1990. NORTH CAROLINA NATIONAL ESTUARINE RESEARCH RESERVE FINAL MANAGEMENT PLAN. State of North Carolina, Dept. of Environment, Health, and Natural Resources, Div. of Coastal Management, Raleigh, N.C. 104 pp. + appendices.

Omwake, H. G. 1955. Recent local finds: Cached argillite blanks found. Archeolog: 7(2): 5-7.

Rothwell, A.D. (chairman) 1988. Delaware's Environmental Legacy: Shaping Tomorrow's Environment Today. Delaware Environmental Legacy Program, Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 181 pp.

Sharp, J.H. (ed.) 1983. The Delaware Estuary: Research as Background for Estuarine Management and Development. Delaware River and Bay Authority; College of Marine Studies, Univ. Delaware; New Jersey Marine Sciences Consortium. Lewes, Delaware. 326 pp.

South Carolina, State of. 1991. Ashepoo-Combahee-Edisto (ACE) Basin National Estuarine Research Reserve in South Carolina, Draft Environmental Impact Statement and Draft Management Plan. Charleston, South Carolina. 164pp.

Steenis, J.H., N.G. Wilder, H.P. Cofer, and R.A. Beck. 1954. The Marshes of Delaware: Their Improvement and Preservation. Pittman-Robertson Publ. No. 2. Delaware Board Fish Game Comm., Dover, Delaware. 42 pp.

Sundstrum, R.W., T.E. Pickett, and R.D. Varrin. 1976. Hydrology, Geology, and Mineral Resources of the Coastal Zone of Delaware.

Technical Report Number 3. Delaware Coastal Management Program. 245 pp.

Tiner, R.W. 1985. Wetlands of Delaware. U.S. Fish Wildlife Service; Delaware Dept. Natural Resources and Environmental Control. Dover, Delaware. 77 pp.

Tucker, A.O., N.H. Dill, C.R. Broome, C.E. Phillips, and M.J. Maciarello. 1979. Rare and Endangered Vascular Plant Species in Delaware. U.S. Fish and Wildlife Service, Newton Corner, Mass. 89 pp.

Virginia, State of. 1989. The Chesapeake Bay Estuarine Research Reserve System in Virginia: Site Nomination and Application for Preacquisition Assistance. Virginia Inst. Marine Science, College of William and Mary, Gloucester Point, Virginia. 310 pp.

U.S. Department of Defense. 1989. Air Installation Compatible Use Zone (AICUZ) Study. Department of the Air Force, Headquarters 436th Military Airlift Wing (MAC), Dover, DE.

U.S. Dept. of Commerce. 1988-1990. Tide Tables: East Coast of North and South America, including Greenland. National Ocean Service, NOAA, U.S. Dept. of Commerce, Riverdale, Maryland.

U.S.D.I. Fish and Wildlife Service. 1989. National Wetlands Priority Conservation Plan. U.S. Fish Wildl. Serv., U.S. Dept. of the Interior, Washington, D.C. 58 pp.

U.S.D.I. Fish and Wildlife Service. 1989. Draft Regional Wetlands Concept Plan, Emergency Wetlands Resources Act. Region 5, U.S. Fish and Wildlife Service, Newton Corner, Mass. 13 pp. + appendices.

Wakelin, J.H. Jr. (chairman) 1972. The Coastal Zone of Delaware. Governor's Task Force on Marine and Coastal Affairs. College of Marine Studies, Univ. Delaware, Newark, Delaware. 464 pp.

Whitman, W.R. 1986. Ecological conditions and suggested habitat management practices for selected coastal impoundments in Delaware. Delaware Coastal Management Program, Annual Report. Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 101 pp.

Whitman, W.R. 1989. An integrated program for the enhancement and management of Delaware's Coastal Wetlands. Delaware Coastal Management Program, Project 65B(1). Delaware Dept. Natural Resources and Environmental Control, Dover, Delaware. 19 pp.

Whitman, William R. and William H. Meredith (eds.) 1987. Waterfowl and Wetlands Symposium: Proceedings of a Symposium on Waterfowl and Wetlands Management in the Coastal Zone of the Atlantic Flyway. Delaware Coastal Management Program, Delaware Department of Natural Resources and Environmental Control, Dover, Delaware. 522 pp.

XXII. BASE RESOURCE INFORMATION

A. PLANT SPECIES LISTS

1. St. Jones River

PLANT SPECIES IDENTIFIED IN THE ST. JONES RIVER COMPONENT

Scientific name	Common Name
Acer rubrum	red maple
Alnus serrulata	common alder
Amelanchier arborea	downy juneberry
Amelanchier canadensis	oblong leaf juneberry
Antennaria plantaginifolia	plantain-leaved pusseytoes
Apios americana	groundnut
Ascyrum hypericoides	St. Andrew's cross
Asplenium platyneuron	ebony spleenwort
Aster novi-belgii	New York aster
Baccharis halimifolia	groundsel bush
Cakile edentula	sea rocket
Carpinus caroliniana	ironwood
Celtis occidentalis	American hackberry
Clethra alnifolia	sweet pepperbush
Cornus florida	dogwood
Diospyros virginiana	persimmon
Distichlis spicata	saltgrass
Erigeron annuus	daisey fleabane
Eupatorium hyssopifolium	hyssop-leaved boneset
Eupatorium serotinum	late-flowering boneset
Fagus grandifolia	American beech
Gaylussacia dumosa	dwarf huckleberry
Gaylussacia frondosa	tall huckleberry
Hamamelis virginiana	witch-hazel
Heterotheca subaxillaris	camphorweed
Hibiscus palustris	swamp rose mallow
Ilex opaca	American holly
Ilex verticillata	winterberry
Impatiens capensis	spotted touch-me-not
Iris versicolor	larger blue flag
Iva frutescens	marsh elder
Juniperus virginiana	red cedar
Kalmia latifolia	mountain laurel
Kosteletzkya virginia	seashore mallow
Leersia oryzoides	rice cutgrass
Lobelia cardinalis	cardinal flower
Lonicera japonica	Japanese honeysuckle
Lycopus americanus	water horehound
Magnolia virginiana	sweetbay
Mikania scandens	climbing hempweed
Nyssa sylvatica	sourgum
Oenothera biennis	common evening primrose
Osmunda cinnamomea	cinnamon fern
Phragmites australis	common reed

Scientific Name	Common Name
Pilea pumila	clearweed
Pluchea purpurescens	saltmarsh fleabane
Polygonum punctatum	water smartweed
Prunus serotina	blackcherry
Quercus alba	white oak
Quercus falcata	spanish oak
Quercus michauxii	basket oak
Quercus palustris	pin oak
Quercus phellos	willow oak
Quercus prinus	chestnut oak
Quercus rubra	red oak
Rubus sp.	blackberry
Sagittaria latifolia	common arrowhead
Salix nigra	blackwillow
Sassafras albidum	sassafras
Saururus cernuus	lizard's tail
Scirpus robustus	stout sedge
Smilax rotundifolia	common greenbrier
Solanum carolinense	horse nettle
Solanum nigrum	black night shade
Solidago bicolor	silverrod
Solidago rugosa	rough-stemmed goldenrod
Spartina alterniflora	saltmarsh cordgrass
Spartina cynosuroides	big cordgrass
Spartina patens	saltmeadow cordgrass
Vaccinium corymbosum	common highbush blueberry
Viburnum nudum	possum haw
Viburnum recognitum	northern arrowwood

2. Blackbird Creek

PLANT SPECIES IDENTIFIED IN THE UPPER BLACKBIRD COMPONENT

Scientific Name	Common Name
Acer rubrum	red maple
Acnida cannabina	salt-marsh water hemp
Amelanchier canadensis	swamp shadbush
Apios americana	groundnut or wild bean
Asclepias incarnata var. pulchra	swamp milkweed
Baccharis halimifolia	groundsel tree
Bidens laevis	larger bur marigold
Carex stricta	a sedge
Cephalanthus occidentalis	buttonbush
Clematis virginiana	virgin's bower
Cornus amomum	silky dogwood
Cornus foemina ssp racemosa	gray dogwood
Cornus florida	flowering dogwood
Cuscuta gronovii	common dodder or love vine
Distichlis spicata	salt grass

Scientific Name	Common Name
Echinochloa walteria	a barnyard grass
Eleocharis fallax (ambigens)	a spike-rush
Eupatorium dubium	Joe-pye weed
Fraxinus pennsylvanica	green ash
Galium obtusum	a bedstraw
Gratiola neglecta	clammy hedge hyssop
Helenium autumnale	sneezeweed
Hibiscus mosheutos	a rose mallow
Hibiscus palustris	marsh mallow
Ilex opaca	American holly
Ilex verticillata	winterberry
Impatiens capensis	jewelweed
Iris versicolor	larger blue flag
Iva frutescens	high tide bush
Juncus acuminatus	a bog-rush
Kosteletzkya virginica	seashore mallow
Leersia oryzoides	a cutgrass
Leucothoe racemosa	fetterbush
Lilium superbum	Turk's cap lily
Liquidambar styraciflua	sweet gum
Liriodendron tulipifera	tulip poplar
Lobelia cardinalis	cardinal flower
Lycopus americanus	water horehound
Lycopus rubellus	a water horehound
Mikania scandens	climbing hempweed
Nuphar luteum (advena)	yellow pond lily
Onoclea sensibilis	sensitive fern
Osmunda regalis	flowering fern
Oxypolis rigidor	cowbane
Panicum virgatum	a panic grass
Peltandra virginica	arrow arum
Phragmites australis	common reed
Pinus taeda	loblolly pine
Pluchea purpurascens	salt-marsh fleabane
Polygonum arifolium	halberd-leaved tearthumb
Polygonum punctatum	water smartweed
Polygonum sagittatum	arrow leaved tearthumb
Pontederia cordata	pickerelweed
Prunus serotina	black cherry
Ptilimnium capillaceum	mock bishop's weed
Quercus alba	white oak
Quercus falcata	red oak
Quercus stellata	post oak
Rorippa islandica	marsh yellow cress
Rosa palustris	swamp rose
Rubus spp.	black cherry
Rumex verticillatus	swamp dock
Sagittaria calycina	an arrowhead
Sagittaria latifolia	common arrowhead
Sagittaria subulata	an arrowhead

Scientific Name	Common Name
Salicornia spp.	saltwort
Sassafras albidum	sassafras
Saururus cernuus	lizards tail
Scirpus pungens	a bulrush
Scirpus robustus	a bulrush
Scirpus validus	a bulrush
Scutellaria lateriflora	a skullcap
Spartina alterniflora	saltmarsh cordgrass
Spartina cynosuroides	big cordgrass
Spartina patens	saltmeadow cordgrass
Stachys tenuifolia	common hedge nettle
Taxodium distichum	bald cypress
Thalictrum polygamum	tall meadow rue
Tilia heterophylla	white basswood
Typha latifolia	common cattail
Ulmus americana	American elm
Viburnum prunifolium	black haw
Viburnum recognitum	arrowwood
Zizania aquatica	wildrice

B. FISH AND WILDLIFE

This section is intended to present some of the traditional uses of the St. Jones River and Blackbird Creek estuaries that are expected to continue in and around the Reserve and may need particular policies established to reduce the potential for conflicts. It has been determined that hunting, trapping, shellfishing, fishing, boating, and agricultural practices are the major traditional activities of these areas. Other traditional activities have not been listed such as bird watching, canoeing, hiking, etc., since they would be activities that would normally be included in the estuarine reserve program.

With the increase in public access to these estuaries and a desire to maintain traditional activities, there is a need to recognize potential conflicts that could result. As much as practical, policies will be established that will allow traditional activities to continue on the Reserve.

Therefore public access will be controlled so that traditional activities will continue with minimal disturbance to both the traditional user and the Reserve activities. Limited access policies, guidelines and general awareness information will need to be developed to provide for the safety of the public. At times, and at some locations, certain traditional activities may be restricted to allow educational and/or research activities to take place. The DNERR Program Manager shall be responsible for establishing a procedure that will regulate both the traditional activities and the educational and research activities to minimize their conflicts. This procedure shall be reviewed annually to assure the optimum blend of all activities.

The following listing of traditional activities is provided in tabulation form to present <u>only</u> <u>an</u> <u>approximation</u> of activities, seasons, dates, times, and conflict potentials. The activities are representative of the area in and around the Reserve boundaries. Some activities may have never occurred within the areas that will be acquired by the Reserve or may not have occurred throughout the seasons, dates or times given.

This information is to be valued as a commitment of the DNERR to continue traditional activities with the realization that conflicts will be reduced by providing guidelines and policies as public access is increased and specific education and research projects are implemented.

TRADITIONAL USES OF THE PROPOSED DNERR ESTUARINE RESOURCES

ST. JONES DNERR COMPONENT

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Agriculture				
Corn	May-Sep			Public Trespassing
Soybean	Jun-Oct			Public Trespassing
Potatoes	Apr-Aug			Dust
Pasture	year			Public Trespassing
Truck Crops	Spring			Dust
Forestry				Visual

Agriculture has been the greatest land-use activity of the St. Jones component for over the last 300 years with consistent boundaries for at least the last 200 years. With proper buffering of the estuary to the normal activities of farming, the Reserve will only be effected by the occasional noise, dust, odors, chemicals and sights of this primary traditional activity. The operations of the Reserve will need to maintain good public access control to prevent straying into farm operations for public safety and public damage to the fences, fields, crops, livestock, and equipment of the Reserve's neighboring farmers.

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Hunting				
White-tailed deer	(with the exception of waterfowl, no other hunting is permitted during the shotgun and muzzleloader seasons for white-tailed deer)			
Archery	Sept to end of Jan except during muzzleloader and shotgun season		1/2hr before sunrise to 1/2hr after sunset	Restriction of hunting to fixed sites compatible with other uses will prevent conflicts
Shotgun	8 days mid-November 2 days mid-January		Same	Same
Muzzleloader	3 days mid-October 3 days mid-January		Same	Same
Wild Turkey	late Aprl-early May		1/2hr before sunrise to 1:00pm	Season not yet set for DNERR components. All other activities should be excluded in areas open to turkey hunting when a season is established except in define no hunting zones

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Small Game				
Gray Squirrel	mid-Sept to mid-Jan		1/2hr before sunrise to 1/2hr after sunset	Exclusions will be required in some section (ie around Center; trails & observation points
Cottontail Rabbit	mid-Nov to mid-Jan		Same	Same
Bobwhite Quail	mid-Nov to Feb 28		Same	Same
Woodchuck	no closed Season		Same	Same
Raccoon	Sept 1 to Feb 28		Same-except some nights	Same
Opossum	Same		Same	Same
Red Fox-(chase only)	Oct 1 to April 30		1/2hr before sunrise to 1/2hr after sunset	Same
Frog	May 1 to Sept 30		Same	Same
Snapping Turtle	June 16 to May 14		Same	Same

Hunting should be accommodated over most of the Component. Numbers of hunters using area at one time may need to be restricted by daily sign-in or another method. No conflicts are anticipated if hunting is properly zoned and regulated.

Migratory Birds			
Mourning Dove	last 3 weeks of Sep last 2 weeks of Oct mid-Dec to mid-Jan	Noon to sunset	Same restrictions apply as upland Game
Rails	3rd week of Oct	Same	Same
Woodcock	mid-Nov - early Jan	Same	Same
Common Snipe	mid-Nov to Jan 31	Same	Same
Gallinules	Sept 1 to early Nov	Same	Same
Crows	mid-June - March 30	Same	Same

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Waterfowl	Nov to	Feb	1/2hr before sunrise to sunset	

All waterfowl hunting must be restricted to fixed blinds and pits established and maintained by DNERR staff.

Numbers of hunters will have to be restricted depending upon number of hunting sites that are established.

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Trapping				
Marshes,Streams & Ditches (leghold or conibear traps-aquatic sets only) Muskrats,mink, otter,raccoon, or opossum	early Dec-mid-March			None as long as trapper's "coming-and-going" is known to the Reserve Manager in order to coordinate with educational/research uses
Upland Areas (box or leghold traps) Raccoon	all year-N side of St Jones; leghold not allowed on S side from mid-March to early Dec			
(box trap) Opossum & rabbit	only during legal hunting season in late fall & winter			
ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
	NOTE: Seasons indicated for commercial/recreational finfishing or shellfishing are traditional times,not legally set periods - there are no legal closed seasons in the tidal rivers for recreational or commercial finfishing nor recreational crabbing.			
Fishing-comm (no commercial shellfishing is allowed in tidal rivers or creeks-no crabs, oysters, clams, mussels) White perch fixed gill nets	Feb-May			None as long as nets do not obstruct navigational channel- no more than 1/3 distance from shore
(no fixed nets in Delaware Bay within 1/2 mile from tidal river mouths) no nets > 200 ft (nets < 200 ft long for Recreational netting)	mid-May to late-September			
American eel (eel pots)	early spring to late fall			Floats to mark pots could cause navigational obstacles if placed too densely

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Fishing-recr (no recreational oystering or clamming allowed)				
Blue crabs (crab pots,2/person)	late-May to late-October			Densely placed floats could cause navigation obstacles
White perch (drifting or anchored boat,shoreline)	early April to June			None
White perch,catfish,crabs (Barkers Landing fishing pier)	Spring to Fall			None Recreational Finfishing Allowed All Year
Bluefish,weakfish striped bass, white perch,etc. (mouth of St. Jones River-shoreline/surf)	Spring to Fall			None
Snapping turtles (may also be sold)	mid-June to mid-May (legal seasons)			None
Female diamondback terrapins	mid-July to early October (legal seasons)			None

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Boating-comm				
Barge (sand & gravel)	Year around			None - unless major dredging is proposed

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Boating-recr				
Drifting or anchored sportfishing in St. Jones River	Spring to Fall			None
Transit for sport fishing of small boats from Barkers Landing to Delaware Bay	Spring to Fall			None

TRADITIONAL USES OF THE PROPOSED DNERR ESTUARINE RESOURCES

BLACKBIRD CREEK DNERR COMPONENT

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Agriculture				
Corn	May-Sep			Public Trespassing
Soybean	Jun-Oct			Public Trespassing
Pasture	year			Public Trespassing

Agriculture is the greatest land-use activity of the Blackbird Creek component. However, development pressures are stressing this tradition. With proper buffering of the estuary to the normal activities of farming, the Reserve will only be effected by the occasional noise, dust, odors, chemicals and sights of this primary traditional activity. The operations of the Reserve will need to maintain good public access control to prevent straying into farm operations for public safety and public damage to the fences, fields, crops, livestock, and equipment of the Reserve's neighboring farmers.

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Hunting				
White-tailed deer	(with the exception of waterfowl, no other hunting is permitted during the shotgun and muzzleloader seasons for white-tailed deer)			
Archery	Sept to February except during muzzleloader and shotgun season		1/2hr before sunrise to 1/2hr after sunset	Restriction of hunting to fixed sites compatible with other uses will prevent conflicts
Shotgun	8 days mid-November 2 days mid-January		Same	Same
Muzzleloader	3 days mid-October 3 days mid-January		Same	Same
Wild Turkey	late Aprl-early May		1/2hr before sunrise to 1:00pm	Season not yet set for DNERR components. All other activities should be excluded in areas open to turkey hunting when a season is established except in defined no hunting zones

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Small Game				
Gray Squirrel	mid-Sept to mid-Jan		1/2hr before sunrise to 1/2hr after sunset	Exclusions will be required in some section (ie around Center; trails & observation points
Cottontail Rabbit	mid-Nov to mid-Jan		Same	Same
Bobwhite Quail	mid-Nov to Feb 28		Same	Same
Woodchuck	no closed Season		Same	Same
Raccoon	Sept 1 to Feb 28		Same-except some nights	Same
Opossum	Same		Same	Same
Red Fox-(chase only)	Oct 1 to April 30		1/2hr before sunrise to 1/2hr after sunset	Same
Frog	May 1 to Sept 30		Same	Same
Snapping Turtle	June 16 to May 14		Same	Same

Hunting should be accommodated over most of the Component. Numbers of hunters using area at one time may need to be restricted by daily sign-in or another method. No conflicts are anticipated if hunting is properly zoned and regulated.

Migratory Birds			
Mourning Dove	last 3 weeks of Sep last 2 weeks of Oct mid-Dec to mid-Jan	Noon to sunset	Same restrictions appl as upland Game
Rails	3rd week of Oct	Same	Same
Woodcock	mid-Nov - early Jan	Same	Same
Common Snipe	mid-Nov to Jan 31	Same	Same
Gallinules	Sept 1 to early Nov	Same	Same
Crows	mid-June - March 30	Same	Same

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL
Waterfowl	Nov to	Feb	1/2hr before sunrise to sunset	

All waterfowl hunting must be restricted to fixed blinds and pits established and maintained by DNERR staff.

Numbers of hunters will have to be restricted depending upon number of hunting sites that are established.

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL

Trapping

Same as St. Jones, except upland trapping for raccoon with either box or leghold traps can occur year around on both sides of the creek (vs. year around only on the north side of the St. Jones; on the south side of the St. Jones, leghold trapping for raccoon can occur only from early December to mid-march).

Fishing-comm

Same as St. Jones, except not closed to commercial or recreational harvest of oysters, clams or mussels - this is because these shellfish are not found here in harvestable quantities.

ACTIVITY	SEASON	DATES	TIMES	CONFLICT POTENTIAL

Fishing-recr

Similar to St. Jones, but no pier or surf fishing; also, more sportfishing in small boats may be occurring in the upper Blackbird for largemouth bass, pickerel, perch, crappie, sunfish, etc. than occurs in the upper St. Jones.

Boating-comm

None

Boating-recr

Similar to St. Jones, but not as much small boat traffic to-and-from Delaware Bay.

XXIII. APPENDICES

A. BIOGEOGRAPHIC CLASSIFICATION AND TYPOLOGY

B. MEMORANDUM OF UNDERSTANDING

C. DELAWARE COASTAL MANAGEMENT PROGRAM CONSISTENCY

D. NERRS REGULATIONS

E. FISH AND WILDLIFE MANAGEMENT PLAN

APPENDIX A

BIOGEOGRAPHIC CLASSIFICATION AND TYPOLOGY

BIOGEOGRAPHIC CLASSIFICATION

Virginian Region
- 4. Middle Atlantic Subregion (Sandy Hook to Cape Hatteras)

TYPOLOGY

Class I - Ecosystem Types

- Group I - Shorelands
  - A. Maritime Forest-Woodland
    - 3. Temperate Deciduous Biome
- Group II - Transition Areas
  - A. Coastal Marshes - Tidal, Non-tidal & Tidal Freshwater
  - B. Coastal Swamps
  - C. Intertidal Beaches
  - D. Intertidal Mud and Sand Flats
  - F. Intertidal Algal Beds
    - 2. Southern Latitudes
- Group III - Submerged Bottoms
  - B. Subtidal Softbottoms
  - C. Subtidal Plants

Class II - Physical Characteristics

- Group I - Geologic
  - A. Basin Type
    - 3. Bay
    - 5. Tidal River
  - B. Basin Structure
    - 1. Coastal plains estuary
  - C. Inlet Type
    - 1. Unrestricted
  - D. Bottom Composition
    - 1. Sand
    - 2. Mud
    - 4. Oyster shell

Group II - Hydrographic
- A. Circulation
  - 1. Stratified
  - 2. Non-stratified
- B. Tides
  - 2. Semidiurnal
  - 3. Wind/Storm Tides
- C. Freshwater
  - 1. Surface water
  - 2. Subsurface water

Group III - Chemical
- A. Salinity
  - 1. Positive estuary
  - 3. Salinity zones
    - c. Mixohaline
      - (2) Polyhaline
      - (3) Mesohaline
      - (4) Oligohaline
- B. pH Regime
  - Circumneutral

APPENDIX B

MEMORANDUM OF UNDERSTANDING

Memoranda of understanding (MOUs) are important with various agencies, groups and organizations in the management of DNERR. Some of these agreements will involve two main management issues: the uses, administration, operations and maintenance of facilities and components; and the interaction of the Reserve with other cooperative programs.

Following is a proposed MOU between DNREC and NOAA/OCRM regarding the Federal-State relationship during the establishment and development of DNERR. This MOU commits DNREC to long term maintenance and management of the DNERR consistent with the national objectives.

DRAFT MEMORANDUM OF UNDERSTANDING

BETWEEN

THE STATE OF DELAWARE

AND

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

The State-Federal Roles in the Delaware National Estuarine Research Reserve.

Preamble

This Memorandum of Understanding ("MOU") is made this day of_____, 1991 by and between the State of Delaware to the benefit of the Department of Natural Resources and Environmental Control ("DNREC"), having an address at 89 Kings Highway, Richardson and Robbins Building, Dover, Delaware 19903 and the National Oceanic and Atmospheric Administration, Department of Commerce ("NOAA"), having an address at the Sanctuaries and Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service/NOAA, 1825 Connecticut Avenue, N.W., Suite 714, Washington, DC 20235 and concerns the establishment and administration of the Delaware National Estuarine Research Reserve ("DNERR").

WHEREAS, DNREC has Determined that the waters and related coastal habitats of the DNERR components provide representative opportunities to study natural and human processes occurring within an estuarine ecosystem; and

WHEREAS, it is the finding of DNREC that the resources of the St. Jones River and Blackbird Creek DNERR components, and the values

they represent to the citizens of Delaware and the United States will benefit from the management of these components as a multiple site National Estuarine Research Reserve; and

WHEREAS, NOAA has concurred with that finding and pursuant to its authority under Section 315 of the Coastal Zone Management Act of 1972 ("CZMA"), as amended, P.L. 92-583, 16 U.S.C. 1461, and in accordance with implementing regulations at 15 CFR 921.30, may designate the areas of the lower St. Jones River and the upper Blackbird Creek as components of the multiple site Delaware National Estuarine Research Reserve; and

WHEREAS, DNREC, as the State agency designated in the management plan for the Reserve ("Plan") and by the State of Delaware as being responsible for managing the Reserve, acknowledges the need and requirement for continuing State-Federal cooperation in the long-term management of the Reserve in a manner consistent with the purposes sought through its designation.

NOW, THEREFORE, in consideration of the mutual covenants contained herein it is agreed by and between DNREC and NOAA, effective on the date of the designation of DNERR, as follows:

ARTICLE I: State-Federal Roles in Reserve Management

A. DNREC, as the principal contact for the State of Delaware in all matters concerning the Reserve, will serve to ensure that the Reserve is managed in a manner consistent with the goals of the National Estuarine Research Reserve System ("NERRS") and the management objectives of the Plan. Its responsibilities for Plan implementation will include the following:

1. Effect and maintain a process for coordinating and facilitating the roles and responsibilities of all agencies involved in the management of the Reserve, including but not limited to:

   a. The administration of facilities, programs, and tasks related to Reserve management;

   b. Education and Research agenda developed and implemented in accordance with corresponding elements of the Plan;

   c. Activities and programs conducted pursuant to the State's Federally-approved coastal management program authorized under the CZMA, as amended; and

   d. Enforcement programs regulating water quality, fish and wildlife habitat protection, sport and commercial fisheries, and non-consumptive recreational activities;

2. As the Governor's designee and the recipient State entity in matters concerning all financial assistance awards authorized under the CZMA, DNREC will apply for, budget, and allocate such funds received for acquisition and development, operation and management, and education, research and monitoring;

3. Subject to appropriations, continue the designation of three State positions to serve as Reserve manager, Education coordinator and Research coordinator;

4. Seek State and other funding for acquisition, development, management, and operation of the Reserve;

5. Seek State and other funding for education and research programs at the Reserve;

6. Serve as principal negotiator on issues involving proposed boundary changes and/or amendments to the Plan;

7. Submit annual reports to NOAA on the Reserve describing, in accordance with 15 CFR 921.40, program performance in implementing the Plan and a detailed work program for the following year of Reserve operations, including budget projections and research efforts;

8. Respond to NOAA's requests for information and to evaluation findings made pursuant to Section 312 of the CZMA; and

9. In the event that it should become necessary, based on findings of program deficiency, serve as the point-of-contact for the State of Delaware in actions involving the possible withdrawal of Reserve designation, as provided at 15 CFR 921.42.

B. Within NOAA, the Sanctuaries and Reserves Division ("SRD"), of the Office of Ocean and Coastal Resource Management ("OCRM") will serve to administer the provisions of Section 315 of the CZMA to ensure that the Reserve is managed in accordance with the goals of NERRS and the Plan. In carrying out its responsibilities, the SRD will:

1. Subject to appropriation, provide financial assistance to DNREC, consistent with 15 CFR 921 for acquisition, development, management, and operation of the Reserve;

2. Subject to appropriation, provide financial assistance to DNREC and other eligible entities for education, research and monitoring programs for the benefit of the Reserve;

3. Serve as the point-of-contact for NOAA in discussion regarding applications for any financial assistance received by DNREC under Section 315 of the CZMA, including any performance standards, compliance schedules, or Special Award Conditions deemed appropriate by NOAA to ensure the timely and proper execution of the proposed work program;

4. Participate in periodic evaluations scheduled by OCRM in accordance with Section 312 of the CZMA to measure DNREC's performance in Plan implementation and its compliance with the terms and conditions prescribed in financial assistance awards granted by NOAA for the Purposes of the Reserve and advise appropriate OCRM staff of existing or emerging issues which might affect the State's coastal management program;

5. Regarding SRD-funded research conducted within the Reserve, maintain communication with DNREC and, in a timely manner, supply the DNREC with copies of all progress reports, final reports, and data sets received by SRD; and

6. Establish an information exchange network cataloging all available research data and educational material developed on each Reserve included within NERRS.

ARTICLE II: Real Property Acquired for the Purposes of the Reserve

DNREC agrees that deeds for any real property that it acquires for the Reserve with federal funds under Section 315 of the CZMA will contain the language set forth in 15 CFR 921.21(e).

ARTICLE III: Program Evaluation

During the period that federal financial assistance is available for Reserve operations and management, OCRM will schedule, pursuant to 15 CFR 921.40, periodic evaluations of DNREC's performance in meeting the conditions of such awards and progress in implementing the Plan and the provisions of this MOU. Where findings of deficiency occur, NOAA may initiate action in accordance with the procedures established at 15 CFR 921.41.

IN WITNESS THEREOF, the parties hereto have caused this MOU to be executed.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Charles N. Ehler
Acting Director
Office of Ocean and Coastal Resource Management
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Date

Joseph A. Uravitch
Chief
Sanctuaries and Reserves Division
Office of Ocean and Coastal Resource management
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

Date

STATE OF DELAWARE

Edwin H. Clark, II
Secretary
Delaware Department of Natural Resources and Environmental Control

Date

David S. Hugg III
Director
Management and Operations
Office of the Secretary
Delaware Department of Natural Resources and Environmental Control

Date

An MOU between DNREC and the Division of Historical and Cultural Affairs will be necessary to operate and manage the Dickinson Plantation Visitors Barn's DNERR section.

Other MOUs will be appropriate as the uses of the Reserve become integral tools to other agencies, schools, groups and organizations that will depend on the attributes of the DNERR to enhance their estuarine programs and the values that their efforts will provide to the Estuarine Reserve System. The Friends of the John Dickinson Mansion, the Kent Conservation District, the Delaware Nature Society, Wesley College, the University of Delaware, Delaware State College, the Cooperative Extension Service, USFW, USDA-SCS, NMFS are a few of the groups that MOU's may be important to the successes of the DNERR.

APPENDIX C

DELAWARE COASTAL MANAGEMENT PROGRAM CONSISTENCY

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

Certification of Consistency with the Delaware Coastal Management Program Request for Federal Grant-in-Aid

SCH#: 90-04-26-05

Project Title: Delaware National Estuarine Research Reserve

Draft Environmental Impact Statement/Draft Management Plan

I hereby certify that the above application for federal aid is consistent with the goals and policies of the Delaware Coastal Management Program as approved by the Office of Coastal Zone Management in September, 1979.

Program Manager

5/6/96

Date

APPENDIX D

NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM PROGRAM

REGULATIONS 15 CFR Part 921

federal register

Monday
July 23, 1990

Part II

Department of Commerce

National Oceanic and Atmospheric Administration

15 CFR Part 921

National Estuarine Reserve Research System Program Regulations; Interim Final Rule

DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

15 CFR Part 921

[Docket No. 70874-0133]

National Estuarine Reserve Research System Program Regulations

AGENCY: Office of Ocean and Coastal Resource Management (OCRM), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce.

ACTION: Interim final rule.

SUMMARY: The regulations revise existing rules for national estuarine reserves in accordance with the Coastal Zone Management Reauthorization Act of 1985 (title IV, subtitle D, Pub. L. 99-272) and recommendations contained in the U.S. Department of Commerce, Office of Inspector General Report No. F-726-5-010, "Opportunities to Strengthen the Administration of the Estuarine Sanctuary Program." Effective with the signing of Public Law 99-272 on April 7, 1986, the name of the Estuarine Sanctuary Program changed to the National Estuarine Reserve Research System Program; estuarine sanctuary sites are now referred to as national estuarine research reserves. These regulations revise the process for designation of research reserves. Greater emphasis is placed on the use of reserves to address national estuarine research and management issues, and to make maximum use of the System for research purposes through coordination with NOAA and other Federal and state agencies which are sponsoring estuarine research. Additional emphasis is also given to providing financial assistance to states to enhance public awareness and understanding of estuarine areas by providing opportunities for public education and interpretation. The regulations provide new guidance for delineating reserve boundaries and new procedures for arriving at the most effective and least costly approach to acquisition of land. Clarifications in the total amount of financial assistance authorized for each national estuarine reserve, and criteria for withdrawing the designation of a reserve, have also been added.

DATES: *Effective Date:* These interim final regulations are effective July 23, 1990.

Comments: Comments are invited and will be considered if submitted on or before September 21, 1990.

ADDRESSES: Mr. Joseph A. Uravitch, Chief: Marine and Estuarine Management Division: Office of Ocean and Coastal Resource Management, NOS/NOAA; 1825 Connecticut Avenue NW.; Suite 714; Washington, DC 20235, (202) 673-5126.

FOR FURTHER INFORMATION CONTACT: Mr. Joseph A. Uravitch, (202) 673-5126.

SUPPLEMENTARY INFORMATION:

I. Authority

This notice of interim final rulemaking is issued under the authority of section 315(a) of the Coastal Zone Management Act of 1972 as amended, 16 U.S.C. 1461 (the Act). The National Estuarine Reserve Research System has been operating under regulations published June 27, 1984 (49 FR 26510).

II. General Background

On October 28, 1988 (53 FR 43816) NOAA published proposed regulations for continued implementation of the National Estuarine Reserve Research System (NERRS) Program pursuant to section 315 of the Act, 16 U.S.C. 1461. Written comments were accepted until December 30, 1988. These comments have been considered in preparing these final regulations. A summary of the significant changes to the proposed regulations is presented below.

These interim final regulations establish the Program's mission and goals and revise procedures for selecting, designating and operating national estuarine research reserves.

III. Changing the Name and Emphasis of the Program

The 1985 Coastal Zone Management Act and its amendments established the National Estuarine Reserve Research System (System). The System consists of (1) each estuarine sanctuary designated prior to April 7, 1986 which is the date of enactment of the Coastal Zone Management Reauthorization Act of 1985, and (2) each estuarine area designated after the Act. The term estuarine sanctuary no longer appears in regulations; the term research reserve or reserve appears in its place.

The Mission Statement for the System is much the same as for the National Estuarine Sanctuary Program which existed prior to the 1985 amendments. However, the goals for the National Estuarine Reserve Research System stress the use of reserve sites for promotion and coordination of estuarine research on a national level as the highest priority and reason for establishing the System. The protection and management of estuarine areas and resources are clearly intended to support the research mission, not as ends in themselves. Consultation by the Secretary with other Federal and state agencies to promote use of one or more reserves within the System by such agencies when conducting estuarine research is also a clearly defined goal of the System. The regulations also emphasize the use of a reserve's natural resources and ecology to enhance public awareness and understanding of estuarine areas, and to provide suitable opportunities for public education and interpretation. This education goal has been elevated to become one of the essential criteria for designation of a reserve.

IV. Revision of the Procedures for Selecting, Designating and Operating National Estuarine Research Reserves

(A) *Revision of Designation Criteria.* The Coastal Zone Management Reauthorization Act of 1985 established, for the first time, statutory criteria for designating an area as a national estuarine research reserve. An area may be designated by the Secretary of Commerce as a national estuarine research reserve if:

(1) the Governor of the coastal state in which the area is located nominates the area for that designation; and

(2) the Secretary finds that:

(A) the area is a representative estuarine ecosystem that is suitable for long-term research and contributes to the biogeographical and typological balance of the System;

(B) the law of the coastal State provides long-term protection for reserve resources to ensure a stable environment for research;

(C) designation of the area as a reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and

(D) the coastal State in which the area is located has complied with the requirements of any regulations issued by the Secretary to implement this section.

Some of these criteria for designation are either new or substantially more specific than those contained in the former regulations. For example, under these regulations the Governor of a coastal state must nominate an estuarine area for designation, and findings are required that the law of the coastal state provides long-term protection for reserve resources to ensure a stable environment for research and that designation of the area will serve to enhance public awareness and understanding of estuarine areas. The criteria in the existing regulations have been revised accordingly.

(B) *Revision of Site Criteria and Procedures.* The criteria for selecting an estuarine area for designation as a national estuarine research reserve have been expanded to provide guidance for determining boundaries for the proposed site. The Office of Inspector General Report No. F–726–5–010 criticized the lack of specific guidelines for setting limits on boundaries around estuarine sanctuaries to ensure that only land essential to the mission of the program be included inside the sanctuary. References in the existing regulations to ensure that the boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit are too vague, particularly since terms are not defined. The proposed regulations define key land and water areas as a "core area" within the reserve which is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the reserve for research on natural processes. The determination of key land and water areas must be based on scientific knowledge of the area. The concept of a "buffer" zone to protect the core area and provide additional protection for estuarine-dependent species has also been defined in the regulations. The buffer zone may include an area necessary for facilities required for research and interpretation, and additionally, to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. States will be required to use scientific criteria to justify the boundaries selected for a proposed site.

The information requirements for NOAA approval of a proposed site under existing regulations were confusing and now have been clarified.

NOAA has recognized the need to conduct studies to develop a basic description of the physical, chemical, and biological characteristics of the site. As a result, states may now be eligible for Federal funding of these studies after NOAA approval of a proposed site.

(C) *Management Plan Development.* Once NOAA approves the proposed site and decides to proceed with designation, the state must develop a draft management plan. The contents of the plan, including the memorandum of understanding (MOU) between NOAA and the state, are specified in the regulations. The acquisition portion of the plan has been greatly expanded to implement recommendations in the Office of Inspector General Report No. F–726–5–010. It is proposed that states be required to justify the use of fee simple acquisition methods and make greater use of non-fee simple methods to conserve expenditure of funds. For each parcel, both in the core area and the buffer zone, states must determine, with appropriate justification (1) the minimum level of control(s) required, (2) the level of existing state control, and (3) the level of additional state control(s) required; states must also examine all reasonable alternatives for attaining the additional level of control required, perform a cost analysis of each, and rank, in order of cost, the alternative methods of acquisition which were considered. The cost-effectiveness assessment must also compare short-term and long-term costs. The state shall give priority consideration to the least costly method(s) of attaining the minimum level of long-term control required, which is sufficient to meet the statutory requirement that "the law of the coastal state provides long-term protection for reserve resources to ensure a stable environment for research. See 16 U.S.C. § 1461(b)(2)(B).

(D) *Financial Assistance Awards for Site Selection and Post Site Selection.*

The first of five types of awards under the National Estuarine Reserve Research System is for site selection and post-site selection, which includes preparation of a draft management plan (including MOU) and the collection of information necessary for preparation of the environmental impact statement. The maximum total Federal share of these awards has been raised to $100,000 as described in § 921.10. Of this amount, up to $25,000 may be used to conduct the site selection process as described in § 921.11. After NOAA's approval of a proposed site and decision to proceed with the designation process, the state may expend (1) up to $40,000 of this amount to develop the draft management plan and collect information for preparation of the environmental impact statement; and (2) up to the remainder of available funds to conduct studies to develop a basic description of the physical, chemical, and biological characteristics of the site.

(E) *Financial Assistance Awards for Acquisition, Development, and Initial Management.* The regulations divide eligibility for financial assistance awards for acquisition and development into two phases. In the initial phase, states are working to meet the criteria required for formal research reserve designation, *i.e.*, establishing adequate state control over key land and water areas in accordance with the draft management plan and preparing a final management plan. In this predesignation phase, funds are available for acquiring interest in land, which is the primary purpose of this award, and for minor construction (*e.g.*, nature trails and boat ramps), preparation of architectural and engineering plans and specifications, development of the final management plan, and hiring a reserve manager and other staff as necessary to implement the NOAA approved draft management plan.

The length of time for this initial phase of acquisition and development may be up to three years. After the site receives Federal designation as a national estuarine research reserve, the state may request additional financial assistance to acquire additional property interests (*e.g.*, for the buffer zone), for construction of research and interpretive facilities, and for restorative activities in accordance with the approved final management plan.

The Coastal Zone Management Reauthorization Act of 1985 specifies that the amount of financial assistance provided with respect to the acquisition of land and waters, or interests therein, for any one national estuarine research reserve may not exceed an amount equal to 50 per centum of the cost of the lands, waters, and interests therein or $4,000,000, whichever amount is less.

The amount of Federal financial assistance provided under the regulations for development costs directly associated with major facility construction (*i.e.*, other than land acquisition) for any one national estuarine research reserve must not exceed 50 per centum of the costs of such construction or $1,500,000, whichever amount is less.

(F) *Financial Assistance Awards for Operation and Management.* The amount of Federal financial assistance available to a state to manage the reserve and operate programs consistent with the mission and goals of the National Estuarine Reserve Research System has been raised from $50,000 to $70,000 for each twelve month period. Up to ten per cent of the total award (Federal and state) each year may be used for construction-type activities.

(G) *Financial Assistance for Research.* The Coastal Zone Management Reauthorization Act of 1985 specifically affects the conduct of the System's research program by establishing the requirement for developing Estuarine Research Guidelines for the conduct of research within the system and specifying what these guidelines shall include. The legislation also requires the Secretary of Commerce to require that NOAA, in conducting or supporting estuarine

research, give priority consideration to research that uses reserves in the System, and that NOAA consult with other Federal and state agencies to promote use of one or more reserves by such agencies when conducting estuarine research.

The research guidelines, which are referred to in the regulations, but are not part of them, state that NOAA will provide research grants only for proposals which address research questions and coastal management issues that have highest national priority as determined by NOAA, in consultation with prominent members of the estuarine research community.

One significant addition to the regulations is that research awards are available on a competitive basis to any coastal state or qualified public or private person, thus making it possible for public or private persons, organizations or institutions to compete with coastal states and coastal state universities for NOAA research funding to work in research reserves.

(H) *Financial Assistance for Monitoring.* The Coastal Zone Management Reauthorization Act of 1985 authorizes the award of grants for the purposes of conducting research and monitoring. While objectives in estuarine research and estuarine monitoring are mutually supportive, monitoring is generally designed to provide information over longer time frames and in a different spatial context. Consequently a separate subpart addressing specifically the development and implementation of monitoring projects has been included in the regulations.

(I) *Financial Assistance Awards for Interpretation and Education.* The Coastal Zone Management Reauthorization Act of 1985 authorizes the award of grants for the purposes of conducting educational and interpretive activities. To stimulate the development of innovative or creative interpretive and educational projects and materials which will enhance public awareness and understanding of estuarine areas, the regulations provide for funds to be available on a competitive basis to any coastal State entity. These funds are provided in addition to any other funds available to a coastal state under these regulations.

Categories of potential educational and interpretive projects include:

(1) Design, development and distribution/placement of interpretive or educational media (*i.e.*, the development of tangible items such as exhibits/displays, publications, posters, signs, audio-visuals, computer software, and maps, which have an educational or interpretive purpose, and techniques for making available or locating information concerning reserve resources, activities, or issues);

(2) Development and presentation of curricula, workshops, lectures, seminars, and other structured programs or presentations for on-site facility or field use;

(3) Extension/outreach programs; or

(4) Creative and innovative methods and technologies for implementing interpretive or educational projects.

Interpretive and educational projects may be oriented to one or more research reserves or the entire System. Those projects which would benefit more than one research reserve, and, if practical, the entire National Estuarine Reserve Research System, shall receive priority consideration for funding.

V. Summary of Significant Comments on the Proposed Regulations and NOAA's Responses

NOAA received comments from 16 sources. Reviewers included Federal and state agencies, academic institutions, and the National Estuarine Research Reserve Association. The comments of the National Estuarine Research Reserve Association (NERRA) are a summary of comments submitted to NERRA by most of the managers of the existing and proposed national estuarine research reserves. All comments received are on file at the Marine and Estuarine Management Division, Office of Ocean and Coastal Resource Management and are available at that office for review upon request. Each of the major issues raised by the reviewers has been summarized and NOAA's responses are provided under the relevant subheading in this section.

General:

Three reviewers recommended that more emphasis be placed on developing an information network among research reserves and between research reserves and research and educational groups and institutions. Two of these reviewers noted the absence in the proposed regulations of a paragraph which had addressed this subject in the existing regulations (49 FR 28502, June 27, 1984). The deleted paragraph concerned the development and Federal administration of a research and education information exchange network for the System.

Response: NOAA agrees. The section referring to information exchange between NOAA and the Reserves has been reinstated in § 921.1(h).

Specific:

Section 921.1—Mission, Goals, and General Provisions

Proposed § 921.1(c)—One reviewer suggested the deletion of the first sentence of this provision which states, "National estuarine research reserves shall be open to the public." This reviewer noted that in multiple component reserves some components may not be appropriate for general public access; either because of the purpose or emphasis of management at that site (*e.g.*, research) or due to the limited interest which the managing entity has in the component (*e.g.*, a conservation easement which does not provide for unlimited public access). This reviewer expressed concern that state denial of general public access at such components of a reserve could be challenged on the basis of this provision.

Response: Consistent with the goal of the National Estuarine Reserve Research System to "enhance public awareness and understanding of the estuarine environment and provide suitable opportunities for public education and interpretation," public access should be allowed to the greatest extent possible permitted under State and Federal law within national estuarine research reserves. However, the statement, "National estuarine research reserves shall be open to the public", does not require that all components of a multi-component reserve or the entire area within the boundaries of a single component reserve be open to the general public unconditionally. The last sentence of § 921.1(c) reads, "Consistent with resource protection and research objectives, public access may be restricted to certain areas within a research reserve." Where unconditional public access is not consistent with resource protection and research objectives as stated in the approved management plan (*e.g.*, public access would interfere with reserve research or is likely to diminish the value of reserve resources for future research) it must be limited accordingly. Just as certain areas are identified in reserve management plans as being more or less sensitive to public access impacts in single component reserves, the same is true of components in multi-component reserves. Frequently in management plans for multi-component reserves one or more components will be identified as those for which the relative management emphasis will be public education and interpretation. Similarly, other components are identified as those

which emphasize research and resource protection.

Proposed § 921.1(d) and § 921.1(e)—Seven reviewers commented on these provisions. These comments ranged from one sentence requesting clarification to approximately six pages of comments dedicated to these provisions alone. These comments also ranged from expressing concern or objection regarding the proposed limitations on habitat manipulation to suggesting a more restrictive approach.

One reviewer expressed strong support for an outright prohibition on habitat manipulation, whether for management or research, except for restoration activities where such restoration can avoid long-term adverse impacts. Another reviewer commented extensively on this provision; expressing strong objections to a prohibition on habitat manipulation activities for management purposes. This reviewer stated that the "preservation" of a habitat requires active management involving habitat manipulation.

One reviewer requested clarification of the difference between restoration activities and habitat manipulation for research or management purposes. One reviewer suggested criteria for assessing the degree of "manipulation" a proposed research project may involve. One reviewer requested clarification of the intent of this provision and how it may apply to: (1) actions necessary to protect public health; (2) protection of existing species; and (3) allowance for restorative activities for historical preservation. One reviewer stated that whatever type of habitat manipulation determined allowable by NOAA, day-to-day site management decisions are best made by the professional staff of each reserve.

One reviewer requested clarification of the intent of this provision and of the differences between habitat manipulation for research, habitat manipulation for management, and habitat manipulation for restoration. This same reviewer stressed the primary importance of the ecological and representative integrity of a reserve.

Response: The mission of the National Estuarine Reserve Research System, as stated in § 921.1(a), "is the establishment and management, through Federal-state cooperation, of a national system of estuarine research reserves *representative of the various regions and estuarine types in the United States*" (emphasis added). The first Secretarial finding required for designation of an estuarine area as a national estuarine reserve under section 315(b)(2)(A) of the Act, 16 U.S.C. 1461(b)(2)(A), is that "the area is a *representative estuarine ecosystem that is suitable for long-term research and contributes to the biogeographical and typological balance of the System*" (emphasis added).

The primary intent of § 921.1(d) and § 921.1(e) is to restrict and allow activities involving habitat manipulation to the degree necessary to ensure that reserves are, and continue to be, *representative estuarine ecosystems*. It is this mission, and requirement of the statute, that the System goals of § 921.1(b) are meant to support. This mission, and requirement of the statute, is the foundation upon which the System is built, the primary basis on which estuarine areas are selected and designated as reserves, and the underlying principle with which all other aspects of reserve development and operation must be consistent. As one reviewer stated, in no case should the ecological or representative integrity of a reserve be comprised.

Habitat manipulation activities conducted for a purpose other than (1) restoring the representative integrity of a reserve or (2) estuarine research, are not consistent with this requirement of the statute or the mission of the System. A reasonable limitation on the nature and extent of habitat manipulation activities conducted as a part of estuarine research is necessary to ensure that the representative integrity of a reserve is protected. Likewise, reasonable exceptions to these limitations on habitat manipulation activities are appropriate for reasons of public health and the protection of other sensitive resources (e.g., endangered/threatened wildlife and significant historical and cultural resources). If habitat manipulation is determined to be necessary in such a case, then such activities should be limited so as not to significantly impact the representative and ecological integrity of the reserve.

Contrary to the assertion of one reviewer, the intent of designating and managing a research reserve is not to "preserve" that particular habitat in a stasis condition. Estuarine ecosystems are naturally dynamic habitats which we have yet to fully understand. NOAA's intent in designating estuarine areas as national estuarine research reserves is to protect the representative character of each individual reserve and thereby establish a national system of estuarine areas representative of the biogeographic regions and estuarine types of the United States. These representative estuarine research reserves then provide opportunities for long-term research, education, and interpretation.

Generally, it is NOAA's belief that, given the less-than-perfect state of knowledge regarding both the functioning of estuarine ecosystems and the effects of natural and anthropogenic change that manipulation should be carefully limited within estuarine research reserves. Outside the context of a carefully planned, and peer reviewed, research or restoration activity, NOAA believes that habitat manipulation for management purposes involves a significant risk to the representative integrity and character of a national estuarine research reserve. As a result, the phrase in the proposed regulations "habitat manipulation for resource management purposes" is intended to mean habitat management for the promotion of a particular species or habitat, or for some purpose other than research involving or restoration of a representative "natural" estuarine ecosystem.

NOAA acknowledges that much research involves some degree of manipulation of the resource(s) and habitat(s) which are the subject of study. In this regard, reserves are not intended to be "control" habitats only, and some degree of habitat manipulation is recognized as an essential aspect of much important estuarine research. However, research activities conducted within a reserve should not involve manipulative activities that, because of their nature or extent, would significantly impair the "natural" representative value (i.e., representative character) of the reserve.

NOAA also acknowledges that restoration efforts may involve extensive habitat manipulation activities. Many estuarine areas have undergone some ecological change as a result of human activities (e.g., hydrological changes, intentional/unintentional species composition changes—introduced and exotic species, etc.). In those areas designated as national estuarine research reserves, such changes may have diminished the representative character and integrity of the site. Where restoration of such degraded areas is determined necessary within this context, such activities must be carefully planned. Much research is necessary to determine the "natural" representative state of an estuarine area (*i.e.*, an estuarine ecosystem minimally affected by human activity or influence). Frequently, such restoration activities provide excellent opportunities for management oriented research.

In response to reviewers requests for clarification and consistent with the response provided above, § 921.1(d) and

§ 921.1(e) have been revised appropriately.

Proposed § 921.1(f)—(1) One reviewer recommended that a formula be established that would "pre-determine the minimum level (percentage) of funds that would be set aside within the total [System] budget for specific categories (Research, Education, Monitoring, Operation/Management, Acquisition, and Development)." In addition, this same reviewer recommended that the allocation of acquisition/development funds should be made on the basis of greatest need measured against predetermined criteria.

Response: NOAA acknowledges that under certain conditions establishment of predetermined percentages for allocating funds among programmatic categories could provide greater predictability in the distribution of Federal funds among reserves. However, the advantages of such an approach depend on a predictability in both the level of annual appropriations as well as major acquisition and development needs for the Reserve system. The uncertainties in appropriation levels and acquisition needs are sufficient enough to make an allocation formula among the six major funding categories (research, education, monitoring, predesignation, acquisition/development, operations) unfeasible.

NOAA attaches primary importance to long term support for the operational needs at each reserve as described in § 921.32 of these regulations, and to fulfilling the research, education and monitoring objectives of the program. unlimited eligibility for these for the awards.

(2) Four reviewers expressed concern or objection to limiting the funding eligibility of any one reserve under any type of award, particularly operation/management awards. These reviewer's comments ranged from general concern to recommending that all funding caps be removed from all types of awards. These reviewers also stated their general concern regarding a perceived lack of long term Federal financial commitment to the System.

Response: Annual appropriations are limited, not unlimited. Funding eligibility limits for each reserve have been established in regulations only where determined appropriate and necessary for the establishment and on-going support of the mission and goals of the System. These regulations establish annual eligibility limits for operations ($70,000 per year, per reserve) and program-life limits for site acquisition ($4 million per reserve). Funding eligibility limits have not been established for research, monitoring, and education grant funds. See subparts F, G, H. Site acquisition limits are statutory. (16 U.S.C. 1461(e)(3)(A))

Funding limits ensure that some funding is available for those types of awards which support most directly the mission and goals of the System (*i.e.*, generally, after designation of a reserve, the competitive awards). As importantly, funding limits are necessary to ensure that available funds are awarded in a relatively fair and proportional manner among national estuarine research reserves. In the absence of such limits, one or a few research reserves could receive the bulk of available funds at the expense of all other reserves. These limits prevent such a substantially disproportionate distribution of limited funding.

At present, some of the existing research reserves in the System are approaching the eligibility limits for acquisition and facility development awards, while most have received less than 50 per cent, and a number less than 25 per cent, of the eligibility limits of these type of awards—a difference between these categories of approximately one to three million dollars. These differences are justifiable on the basis of relative need, reserve size, property values, construction costs, etc. A greater difference in relative allocation of funds between reserves would favor disproportionally some reserves and, as a result, be detrimental to the System as a whole.

Eligibility limits are established for the purposes noted above and not to unreasonably restrict a research reserve from access to available Federal funds. On the basis of NOAA's experience in administering Federal financial assistance for the System and because of comments from many research reserves, the eligibility limit for operation/management awards was raised to a maximum of $70,000 per site per year. In response to comments on the proposed regulations, the eligibility limit for major facility construction has been raised 50 per cent in these final regulations (see response under proposed § 921.31 below).

Proposed § 921.1(g)—One reviewer disagreed with the requirement that land already in a protected status can be included within a reserve only if the managing entity commits to long-term non-manipulative management.

Response: NOAA believes this requirement is necessary consistent with the mission and goals of the System. Essentially this same subject is discussed in the response to comments on proposed § 921.1(d) and § 921.1(e). In order to clarify the intent of this provision, NOAA has revised this sentence to include a reference to the revised § 921.1(d) and § 921.1(e).

Section 921.2—Definitions

Proposed § 921.2(b)—It was noted that the Secretary of Commerce recently delegated authority for matters relating to National Estuarine Research Reserves to the Under Secretary for Oceans and Atmosphere.

Response: NOAA agrees with the recommended modification and has changed references from the Assistant Administrator to the Under Secretary throughout.

Proposed § 921.2(d)—One reviewer recommended a modification to the second sentence of the definition of estuary to include the term measurably diluted with freshwater rather than minimally diluted.

Response: NOAA agrees with the recommended modification the recommended term "minimal" should be the term "measurable". The definition has been changed accordingly.

Proposed § 921.2(e)—Five reviewers stated that some confusion has resulted in the reversed order of the terms research and reserve in the name of the System, National Estuarine Reserve Research System, and the name of each individual reserve, national estuarine research reserve.

Response: NOAA acknowledges that some confusion has arisen as a result of this difference. However, this is statutory language which only can be changed by amending the Act.

Section 921.4—Relationship to Other Provisions of the Coastal Zone Management Act.

It was noted that the existing program regulations describe this section as "Relationship to other provisions of the Coastal Zone Management Act and to the National Marine Sanctuary Program". Text describing the relationship between the Reserve and Sanctuary Programs was omitted. New marine sanctuaries and estuarine research reserves are being designated in close geographic proximity to one another and therefore improved coordination between the two programs is warranted.

Response: NOAA agrees. The revision of the Section heading and text should be adopted and strengthened. The omission of this information from the proposed regulations was an oversight. The Section heading and text have been revised appropriately.

Section 921.10—General

Proposed § 921.10(a)—Five reviewers objected to two or more states which

share a biogeographic region being limited to the development of a single reserve, even if it was a multicomponent reserve with components in each respective state (*e.g.*, Maryland and Virginia in the Chesapeake Bay subregion of the Virginia biogeographic region). These reviewers specifically objected to the eligibility limit on land acquisition funding (see § 921.10(b) and § 921.20) as it applies to any individual reserve, single or multiple component.

Response: NOAA agrees. Some of the System's biogeographic subregions are represented by more than one reserve in more than one state. As a result, in the case of a biogeographic region (see Appendix 1) shared by two or more states, each such state should be eligible for Federal financial assistance to establish a national estuarine research reserve within their respective portion of the shared biogeographic region. Section 921.10(a) has been amended to reflect this revision. Because of this revision, the phrase which begins "In the case of a multicomponent national estuarine * * *" in § 921.10(a), § 921.31, and § 921.32(c) is no longer necessary and has been deleted.

Proposed § 921.10(b)—Two reviewers commented that NOAA should consider a higher eligibility limit or relative greater funding for awards to multi-component reserves than to single component reserves.

Response: NOAA disagrees. Funding for the System is limited. A State elects to establish a multi-component reserve or expand a single component reserve with full knowledge of the identical eligibility limits on any individual reserve, whether single or multiple component. Establishing separate funding eligibility limits for, or disproportionally funding, multicomponent reserves would be likely to have a significant adverse impact on single component reserves and, as a result, the System as a whole. Further, acquisition and development funds are limited by the Act.

Section 921.11—Site Selection

Proposed § 921.11(c)(2)—One reviewer recommended that the last sentence be revised to eliminate reference to "a natural system."

Response: NOAA agrees that a minor revision is necessary to clarify the intent of this sentence. The sentence has been revised in a manner consistent with corresponding clarifying revisions to § 921.1(d) and § 921.1(e).

Proposed § 921.11(c)(3)—Three reviewers commented on the concept of "core" and "buffer" areas or zones. Two of these reviewers recommended deleting the concept of a buffer zone. The remaining reviewer recommended extensive revisions to the subsection to provide guidance on where habitat manipulation would be allowed.

Response: After careful review of this subsection, NOAA does not believe that the buffer zone concept should be deleted or that substantive revisions are appropriate. The basic approach presented is sound. A critical concept and distinction between the two areas which may have been overlooked is that key land and water areas ("core") and a buffer zone will likely require significantly different levels of control (see § 921.13 (a)(7)). In addition to the basic principles established in the regulations, NOAA has developed more detailed boundary guidance which is available to states attempting to conduct the difficult process of boundary delineation of a proposed site.

Proposed § 921.11(c)(5)—One reviewer recommended amending this site selection principle to include "the support of ongoing or planned management activities in nearby estuaries, including those in the National Estuary Program."

Response: NOAA considers § 921.11(c)(5) to encompass this concern in that the State is required to demonstrate how the proposed site is consistent with existing and potential land and water uses. Both the designation by NOAA of a reserve under the Act and management plans developed through the National Estuary Program of the U.S. EPA are submitted to the States for a determination of consistency under section 307(c)(1) of the Coastal Zone Management Act of 1972, as amended. NOAA views this mechanism as an effective means for ensuring that Reserves support and advance the relevant coastal and estuarine management objectives including those of the National Estuary Program. Therefore, § 921.11(c)(5) has been amended to make more specific our intent that the site support estuarine management objectives.

Section 921.12—Post Site Selection

Proposed § 921.12(a)—Two reviewers recommended a separate type of award for monitoring that would provide long-term support for these activities.

Response: NOAA agrees. A new subpart G—Monitoring has been added to the regulations (subparts G and H of the proposed regulations being relettered as subparts H and I, respectively; and the section numbers being renumbered accordingly). Initial funding for basic characterization of the physical, geological, chemical, and biological characteristics of the site will continue to be provided under § 921.12—Post site selection. In addition, however, under the new subpart G, NOAA may provide financial assistance on a competitive basis for each phase of a monitoring program. These grant awards will be separate from those provided for estuarine research under subpart F.

Section 921.13—Management Plan and Environmental Impact Statement Development

Proposed § 921.13(a)(7)—Three reviewers provided comment on the acquisition plan guidance of this subsection. Two reviewers requested additional guidance on what constitutes "adequate state control" and commented that the requirement to assess the cost effectiveness of control alternatives is excessively burdensome. The remaining reviewer stated that having four million dollars in funds available for land acquisition is not consistent with the requirement to conduct an assessment of the cost effectiveness of acquisition alternatives.

Response: What constitutes "adequate State control" is dependent on site-specific circumstances and requirements. The most efficient use of available acquisition funds can only be ensured through the identification of reasonable control, or acquisition alternatives and an assessment of their relative cost and effectiveness. This does not necessarily mean that the least costly option in dollars is the alternative that must be selected. It does mean, however, that all reasonable control alternatives should be thoroughly examined and their relative costs identified. The development of an acquisition plan is an allowable cost (Federal or matching share). Four million dollars is not "available," but is the eligibility limit for land acquisition funds for any one reserve. Regardless of the amount of funding available, for land acquisition, a thorough assessment of acquisition alternatives and their cost effectiveness is necessary to ensure responsible and efficient use of Federal grant funds. At a minimum the degree of state control must provide adequate long term protection to ensure for reserve resources a stable environment for research.

Proposed § 921.13(a)(11)—One reviewer stated that NOAA's responsibility to make a consistency determination should be made clear early in the regulations.

Response: NOAA agrees. A reference to § 921.30(b) has been added to this subsection to clarify NOAA's consistency determination responsibilities early in preparation of the management plan.

Section 921.20—General

Proposed § 921.20—Two reviewers requested a clarifying revision to the last sentence of this subsection; the addition of the phrase "to a coastal state."

Response: NOAA agrees and the section has been revised accordingly.

Section 921.21(e)—Initial Acquisition and Development Awards

Two reviewers provided comment on this section. The first reviewer requested clarification that the provision regarding de-designation of a site applies only to properties acquired with Federal funds. The second reviewer stated that the provision to compensate the Federal government for its share of the acquisition cost in the event of de-designation, may be contrary to overall coastal protection objectives because the state may have to sell the property to development interests in order to fully compensate the Federal interest.

Response: Regarding the first comment, NOAA does not believe additional clarification is necessary. This subsection states specifically that these provisions apply to "any real property acquired in whole or part with Federal funds * * *." The second commenter acknowledges correctly that these requirements are designed to accomplish the goals of the National Estuarine Research Reserve System and that this provision helps ensure that reserves maintain the standards established for the system and, if they do not, that a percentage of the fair market value is available to other reserves. It should also be noted that these provisions are not new and have been in place since the inception of the Reserve program through grant directives contained in OMB Circular A-102. The provisions in the Reserve regulations are taken directly from the A-102 Circular and apply to all real property acquired in whole or part with Federal funds. It should also be noted that there are other alternatives aside from sale of the property. In the event of de-designation the state may retain title or transfer title to the Federal government. In these instances it is likely that the resources of the reserve could continue to be protected. While none of these alternatives are inexpensive they do, as noted by the commenter, help ensure that the site continues to be managed and maintained in conformance with research reserve goals and objectives.

Section 921.30—Designation of National Estuarine Research Reserves

Proposed § 921.30(a)—Two reviewers provided comments on the designation criteria listed in this subsection. One reviewer recommended a change in (a)(4) at variance with the Act. The other reviewer recommended an addition to the designation findings to include a requirement that, in the case of a State which contains, in whole or part, a national estuary program convened pursuant to section 320 of the Clean Water Act, suitable consideration has been given to integration of research and public education programs of the estuarine research reserve and the national estuary program. It has also been noted that the final management plan as the governing document for subsequent operations and management of the reserve should contain the signed designation findings. Subpart (a) of this section should also be revised to show that the Under Secretary is responsible for designation of reserves in accordance with the delegation of that authority from the Secretary of Commerce.

Response: The terms for designation of a National Estuarine Research Reserve are set forth in the statute. NOAA agrees that research and education programs should be integrated between the Environmental Protection Agency's National Estuary Program and NOAA's National Estuarine Reserve Research System. This effort has already been initiated through a memorandum of understanding between the programs at the National level and is being pursued at the local level, where appropriate. Therefore, NOAA believes it does not require restatement in the program regulations. However, NOAA agrees that the management plan should contain the findings of designation and the regulations should show that the Under Secretary is responsible for designation. The regulations have been revised accordingly.

Section 921.31—Supplemental Acquisition and Development Awards

Proposed § 921.31—Four reviewers expressed concerns that the eligibility limit of $1,000,000 in Federal financial assistance for facility construction may not be adequate to meet anticipated long term needs and should be increased or eliminated.

Response: NOAA agrees. The eligibility limit for facility construction has been increased 50 percent to $1,500,000.

Section 921.32—Operation and Management: Implementation of the Management Plan

Proposed § 921.32(a-d)—Seven reviewers objected to the eligibility limit on operations and management awards. They noted that the statute contains no provision for withdrawal of Federal support for continued operation of the reserves. The termination of Federal support for the individual sites is viewed as a lack of Federal commitment to the long-term maintenance of a representative system of estuarine research and education sites.

Response: The Reserve Program was designed and continues to be a State-Federal partnership. The key to this partnership is the requirement that NOAA share with the State reserve program the financial needs associated with site designation, land acquisition, research, education and operations.

As discussed previously, appropriate eligibility limits ensure that funding is available for competitive research education and monitoring awards. If, as some reviewers suggested, NOAA removed the annual monetary ceiling for operations and other awards, an inequitable and disproportionate distribution of the limited funds for the program could result. Annual operational eligibility limits in addition to ensuring the availability of funds for competitive projects provide a stability and even distribution among designated and developing reserves. Consequently NOAA is retaining the eligibility limit of $70,000 for operations and management per site per year.

NOAA concurs with the reviewers' assertion that the statute does not direct the Federal Government to abandon its support and financial commitment to reserve operations at the conclusion of a prescribed period of time or when an arbitrary cumulative funding ceiling for Federal support of operations has been met. By imposing a fixed duration for Federal support of Reserve operations NOAA may undermine its ability to participate effectively with the Reserve system to address coastal and estuarine management issues of national significance. The previously proposed three year support per position allocated through a $420,000 operations ceiling also established a complex and burdensome administrative process which is further complicated when allocated among Reserves which have already received operations support, and the newly designated sites which have yet to receive such support. To simplify, streamline and improve NOAA's effectiveness in support of

Reserve operations, the three year restriction and other references to cessation of Federal support for operations and management at the reserves have been removed throughout the regulations.

Section 921.33—Boundary Changes, Amendments to the Management Plan, and Addition of Multiple-site Components

Proposed § 921.33(a)—One reviewer recommended deletion or substantial modification of this subsection to recognize the State's right and ability to appropriately plan and legislate its legal charge—the research reserve. In summary, this reviewer objected to NOAA's approval authority/requirement for activities discussed in this subsection. The reviewer suggested that it should be sufficient if the State provides NOAA an opportunity for review and comment on proposed changes.

Response: NOAA disagrees. NOAA is responsible for Federal oversight of the System and each designated research reserve. As long as a State wishes for a reserve to remain a part of the System and to retain Federal designation, NOAA will continue to require Federal approval of changes in that research reserve's boundaries and management.

General

Proposed § 921.40, § 921.41, and § 921.42—Several reviewers recommended clarification of the criteria to be used during performance evaluations. Performance criteria should clearly state what constitutes adequate or inadequate performance. One commenter provided a list of items suggested for inclusion in an evaluation. Three reviewers made suggestions on the composition of the evaluation team recommending non-Federal and private individual participation while another commenter suggested the regulations indicate criteria for choosing the members of the evaluation team. Finally a recommendation was offered that the evaluation stress integration of the Reserve program with other state coastal/research programs and that the regulations provide for other dispute resolution mechanisms short of litigation.

Response: The periodic evaluation of a national estuarine research reserve is central to NOAA's ability to ensure that reserve operation and management is being conducted in a manner fully consistent with program goals and objectives as defined in section 315 of the Act, 16 U.S.C. 1461, and its implementing regulations. The criteria for an evaluation corresponds directly with the program goals as specified in § 921.1 of these regulations. The five goals described in this section are nearly identical to the criteria proposed by one commenter. The commenter added cost-effectiveness in using Federal funds as an additional criteria which, while not directly stated as a program goal in the regulations is implicit in any evaluation of efficient management of the total reserve program.

It is not feasible to establish a checklist for any evaluation to predetermine what constitutes adequate versus inadequate performance. Each reserve has very unique administrative structures, environmental resources, and corresponding management needs. NOAA views the evaluation process to be a highly collaborative effort with the State such that the evaluation can be used to focus on particular and specific problem areas. It is not appropriate to attempt to construct a litmus test for inadequate or adequate performance which could reasonably anticipate the substantial variety of issues that are addressed in the evaluation process. NOAA would be justifiably criticized for applying an artificial measure against unique and site-specific circumstances.

NOAA agrees with the comments made regarding participation of other officials in the evaluation process. Such officials provide recommendations to NOAA on specific issues in the evaluation. To ensure that Reserve personnel are directly involved in selection of the evaluation team, § 921.40(c) has been revised to indicate that NOAA will consult with and request recommendations from the Reserve on the appropriate non-NOAA participants prior to the evaluation.

The recommendation that the evaluation examine coordination between the Reserve program and other coastal research efforts is fully consistent with NOAA objectives for the evaluation process and is currently considered under Reserve program criteria to "promote Federal, State, public and private use of one or more reserves within the System when such entities conduct estuarine research." NOAA however, does not agree with the comment that other dispute resolution mechanisms should be devised short of litigation in the event of an unfavorable evaluation that may lead to withdrawal of designation. The provisions contained in both § 921.41 and § 921.42 provide a lengthy and elaborate process for addressing major differences between the NOAA and the Reserve relative to suspension of financial assistance or withdrawal of designation. This process is expressly designed to avoid litigation on these issues. Therefore, NOAA does not agree that additional mechanisms for dispute resolution are warranted.

Proposed § 921.40(e)—Two reviewers recommended a ninety-day requirement for State submittal of an annual report instead of sixty days.

Response: NOAA agrees. Section 921.40(e) has been revised accordingly. NOAA also notes that this section indicates that inadequate annual reports will trigger a full scale performance evaluation. This provision is no longer needed since § 921.32 has been changed to provide long term eligibility for operations support. Evaluations consequently will be conducted generally at least every 3 years. The statement has therefore been deleted.

Section 921.50—General

Proposed § 921.50(a)—Four reviewers commented on this subsection. Three reviewers recommended that research funded under this subpart be allowed in an area larger than the boundaries of the research reserve. One of these reviewers also recommended that the managing entity of the reserve approve all research prior to NOAA funding. One reviewer expressed concern that funding eligibility is tied to NOAA approval of a final management plan.

Response: NOAA agrees that greater flexibility should be provided for the area in which federally funded research under this subpart may be conducted. The regulations have been revised to allow research activity in the immediate watershed of the reserve while still requiring the majority of funded activities to be conducted within the boundaries. NOAA also agrees that the managing entity of the reserve should directly indicate approval or disapproval of proposed research project. Currently each reserve is requested to review and assign priority to research projects proposed for the reserve. If a reserve does not approve of a particular project that information should be expressed directly to NOAA.

NOAA agrees that its review and approval of state submitted final management plans should be as expeditious as possible. However, consistent with NOAA's responsibility to ensure that reserve management is conducted in accordance with the mission and goals of the System, the need for an approved final management plan to qualify for NOAA funded research remains.

Section 921.51—Estuarine Research Guidelines

Proposed § 921.51—Five reviewers recommended that NOAA provide, at

minimum, a more detailed and specific description of the Estuarine Research Guidelines in the regulations. One reviewer objected to NOAA's role in establishing the research priorities for funding under this subpart.

Response: NOAA disagrees. Section 315 of the Act requires NOAA to develop guidelines, not regulations, for the conduct of research within the System. A basic description of these guidelines is provided in both the Act and the regulations. Including the guidelines themselves, or a more detailed and specific description of these guidelines, in the regulations would severely limit flexibility in their implementation. NOAA publishes the guidelines annually in the Federal Register and intends to continue to improve these guidelines within the relatively comprehensive standards of the Act. NOAA develops general research priorities on an annual basis in consultation with the estuarine research and resource management community. The agency foresees no advantage to including more specificity or detail than necessary in the Program regulations. The financial support provided under this subpart for Research is administered by NOAA. As a result, NOAA, in consultation with prominent members of the estuarine research community, will continue to determine research priorities for this funding.

Subpart G—Interpretation and Education

Section 921.60—General

Proposed § 921.60(a)—Two reviewers objected to the requirement that interpretive and education projects be conducted within the research reserve.

Response: NOAA did not intend to limit funding under this Subpart to activities conducted entirely within the boundaries of a research reserve, and has revised the statement to clarify the intent.

Proposed § 921.60(b)—One reviewer suggested NOAA require that all applications for interpretation and education awards be approved by the state.

Response: NOAA agrees that applications under this subpart should have the support of the state managing entity. The regulations have been revised accordingly.

Section 921.71—Allowable Costs

Proposed § 921.71(e)(2)—Two reviewers objected to a one year time limit prior to pre-acquisition being imposed on the allowability for state match of state lands already in a fully-protected status. The commenters noted that properties included within NERR boundaries, particularly the core area, will be subject to restricted uses, and these uses will be subject to NOAA approval (*e.g.*, research, construction, education). Since these properties add real value to the NERR System, but have diminished use for other purposes, they should be allowable as state match. These reviewers therefore recommended elimination of a one-year time limit.

Response: This provision has been adopted in the past to ensure that lands included within the Reserve system are acquired consistent with the purposes and objectives of the Reserve system and, as required by section 315(e)(3)(A) of the Act, to assure that the state has matched the amount of financial assistance provided by the Federal Government for the acquisition of land for a reserve. However, NOAA agrees that the imposition of a one-year time limit may not be the most effective or appropriate method to achieve this purpose. We have therefore eliminated this provision from the regulations and instead allow inclusion of land and submerged lands already in the states' possession as state match irrespective of the date obtained by the state. However, calculation of the amount eligible as match for existing state owned lands will be made by an independent appraiser who will consider the value for match purposes of these lands by calculating the value of benefits foregone by the state, in the use of the land, as a result of new restrictions that may be imposed by Reserve designation.

Proposed § 921.71(e)(4)—One reviewer recommended elimination or simplification of the matching share criteria for research awards.

Response: The matching share requirement cannot be eliminated because it is required by statute. However, the matching share criteria has been simplified to be consistent with the provisions to § 921.50(a) of subpart F.

VI. Other Actions Associated With the Rulemaking

(A) *Classification Under Executive Order 12291.* NOAA has concluded that these regulations are not major because they will not result in:

(1) An annual effect on the economy of $100 million or more;

(2) A major increase in costs or prices for consumers; individual industries; Federal, state, or local government agencies; or geographic regions; or

(3) Significant adverse effects on competition, employment, investment, productivity, innovation or the ability of United States based enterprises to compete with foreign based enterprises in domestic or export markets.

These rules amend existing procedures for identifying, designating, and managing national estuarine research reserves in accordance with the Coastal Zone Management Reauthorization Act of 1985. They will not result in any direct economic or environmental effects nor will they lead to any major indirect economic or environmental impacts.

(B) *Regulatory Flexibility Act Analysis.* A Regulatory Flexibility Analysis is not required for this rulemaking. The regulations set forth procedures for identifying and designating national estuarine research reserves, and managing sites once designated. These rules do not directly affect "small government jurisdictions" as defined by Public Law 96-354, the Regulatory Flexibility Act, and the rules will have no effect on small businesses.

(C) *Paperwork Reduction Act of 1980.* This rule contains collection of information requirements subject to Public Law 96-511, the Paperwork Reduction Act (PRA), which have already been approved by the Office of Management and Budget (approval number 0648-0121). Public reporting burden for the collections of information contained in this rule is estimated to average 2,012 hours per response for management plans and related documentation, 1.25 hours for performance reports, and 15 hours for annual reports and work plans. These estimates include the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of these collections of information, including suggestions for reducing this burden, to Richard Roberts, Room 1235, Department of Commerce, Washington, DC 20230, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503. ATTN: Desk Officer for NOAA.

(D) *Executive Order 12612.* These interim final rules do not contain policies which have sufficient Federalism implications to warrant preparation of a Federalism Assessment pursuant to Executive Order 12612. However, the provisions of the rules setting forth what a state must do or agree to do in order to qualify for the various types of Federal financial assistance available under the rules have been reviewed to ensure that the

rules grant the states the maximum administrative discretion possible in the administration of the National Estuarine Reserve Research System policies embodied in the qualification requirements. In formulating those policies, the NOAA worked with affected states to develop their own policies with respect to the use of National Estuarine Research Reserves. To the maximum extent possible consistent with the NOAA's responsibility to ensure that the objectives of the National Estuarine Reserve Research System provisions of the Coastal Zone Management Act are obtained, the rules refrain from establishing uniform national standards. Extensive consultations with state officials and organizations have been held regarding the financial assistance qualifications imposed. Details regarding awards of financial assistance have been discussed above under the heading "REVISION OF THE PROCEDURES FOR SELECTING, DESIGNATING AND OPERATING NATIONAL ESTUARINE RESEARCH RESERVES" and are not repeated here. Likewise comments from the states regarding qualifications and responses and changes to the regulations regarding same were set forth under the heading SUMMARY OF SIGNIFICANT COMMENTS ON THE PROPOSED REGULATIONS AND NOAA'S RESPONSES. It should be noted that some of the states commented in opposition to conditions or language required by law or by Office of Management and Budget Circular A-102. NOAA does not have the discretion to change such language or conditions.

(E) *National Environmental Policy Act.* NOAA has concluded that publication of these interim final rules does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement is not required.

(F) *Administrative Procedure Act.* These interim final regulations are effective July 23, 1990. To the extent that these regulations relate to grants and cooperative agreements the requirements of the Administrative Procedure Act 5 U.S.C. 553 do not apply. To the extent that any substantive provision does not involve grants or cooperative agreements no useful purpose would be served by delaying the effective date for 30 days. No rights of the participants in this Federal program will be adversely effected by immediate implementation. To the contrary state recipients of financial assistance through this program have submitted program applications that anticipate immediate implementation of these regulations. Public comments on these interim final regulations are invited and will be considered if submitted on or before September 21, 1990.

List of Subjects in 15 CFR Part 921

Administrative practice and procedure, Coastal zone, Environmental impact statements, Grant programs—Natural resources, Reporting and recordkeeping requirements, Research.

(Federal Domestic Assistance Catalog Number 11.420, National Estuarine Reserve Research System)

Dated: July 10, 1990.

Virginia K. Tippie,

Assistant Administrator for Ocean Services and Coastal Zone Management.

For the reasons set forth in the preamble, 15 CFR part 921 is revised to read as follows:

PART 921—NATIONAL ESTUARINE RESERVE RESEARCH SYSTEM REGULATIONS

Sec.

Authority: Sec. 315, Public Law 92-583, as amended; 86 Stat. 1280 (16 U.S.C. 1461).

Subpart A—General

§ 921.1 Mission, goals and general provisions.

(a) The mission of the National Estuarine Reserve Research System is the establishment and management, through Federal-State cooperation, of a national system of estuarine research reserves representative of the various regions and estuarine types in the United States. Estuarine research reserves are established to provide opportunities for long-term research, education, and interpretation.

(b) The goals of the program for carrying out this mission are to:

(1) Ensure a stable environment for research through long-term protection of estuarine reserve resources;

(2) Address coastal management issues identified as significant through coordinated estuarine research within the System;

(3) Enhance public awareness and understanding of the estuarine environment and provide suitable opportunities for public education and interpretation;

(4) Promote Federal, state, public and private use of one or more reserves within the System when such entities conduct estuarine research; and

(5) Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

(c) National estuarine research reserves shall be open to the public to

the extent permitted under State and Federal law. Multiple uses are allowed to the degree compatible with the research reserve's overall purpose as provided in the management plan (see § 921.13) and consistent with paragraphs (a) and (b) of this section. Use levels are set by the individual state and analyzed in the management plan. The research reserve management plan shall describe the uses and establish priorities among these uses. The plan shall identify uses requiring a state permit, as well as areas where uses are encouraged or prohibited. Consistent with resource protection and research objectives, public access may be restricted to certain areas within a research reserve.

(d) Habitat manipulation for research purposes is allowed consistent with the following limitations. Manipulative research activities must be specified in the management plan, be consistent with the mission and goals of the program (see paragraphs (a) and (b) of this section) and the goals and objectives of the affected research reserve, and be limited in nature and extent to the minimum manipulative activity necessary to accomplish the stated research objective. Manipulative research activities with a significant or long-term impact on reserve resources require the prior approval of the state and the National Oceanic and Atmospheric Administration (NOAA). Manipulative research activities which can reasonably be expected to have a significant adverse impact on the estuarine resources and habitat of a reserve, such that the activities themselves or their resulting short- and long-term consequences compromise the representative character and integrity of a reserve, are not allowed. Habitat manipulation for resource management purposes is not permitted within national estuarine research reserves, except as allowed for restoration activities consistent with paragraph (e) of this section. NOAA may allow an exception to this prohibition if manipulative activity is necessary for the protection of public health or the preservation of other sensitive resources which have been listed or are eligible for protection under relevant Federal or state authority (*e.g.*, threatened/endangered species or significant historical or cultural resources). If habitat manipulation is determined to be necessary for the protection of public health or the preservation of sensitive resources, then these activities shall be specified in the Reserve Management Plan and limited to the reasonable alternative which has the least adverse and shortest term impact on the representative and ecological integrity of the reserve.

(e) Under the Act an area may be designated as an estuarine reserve only if the area is a representative estuarine ecosystem that is suitable for long-term research. Many estuarine areas have undergone some ecological change as a result of human activities (*e.g.*, hydrological changes, intentional/unintentional species composition changes—introduced and exotic species). In those areas proposed or designated as national estuarine research reserves, such changes may have diminished the representative character and integrity of the site. Although restoration of degraded areas is not a primary purpose of the System, such activities may be permitted to improve the representative character and integrity of a reserve. Restoration activities must be carefully planned and approved by NOAA through the Reserve Management Plan. Historical research may be necessary to determine the "natural" representative state of an estuarine area (*i.e.*, an estuarine ecosystem minimally affected by human activity or influence). Frequently, restoration of a degraded estuarine area will provide an excellent opportunity for management oriented research.

(f) NOAA may provide financial assistance to coastal states, not to exceed 50 percent of all actual costs or $4 million whichever amount is less, to assist in the acquisition of land and waters, or interests therein. NOAA may provide financial assistance to coastal states not to exceed 50 percent of all actual costs for the management and operation of, and the conduct of educational or interpretive activities concerning, national estuarine research reserves (see subpart I of this part). NOAA may provide financial assistance to any coastal state or public or private person, not to exceed 50 percent of all actual costs, to support research and monitoring within a national estuarine research reserve. Five types of awards are available under the National Estuarine Reserve Research System Program. The predesignation awards are for site selection, draft management plan preparation and conduct of basic characterization studies. Acquisition and development awards are intended primarily for acquisition of interests in land and construction. The operation and management award provides funds to assist in implementing the research, educational, and administrative programs detailed in the research reserve management plan and is reflective of the joint State-Federal partnership in the preservation and protection of estuarine resources. The research and monitoring awards provide funds to conduct estuarine research and monitoring within the System. The educational and interpretive award provides funds to conduct estuarine educational and interpretive activities within the System.

(g) Lands already in protected status managed by other Federal agencies, state or local governments, or private organizations can be included within national estuarine research reserves only if the managing entity commits to long-term non-manipulative management consistent with paragraphs (d) and (e) of this section in the reserve management plan. Federal lands already in protected status cannot comprise the key land and water areas of a research reserve (see § 921.11(c)(3)).

(h) To assist the states in carrying out the Program's goals in an effective manner, the National Oceanic and Atmospheric Administration (NOAA) will coordinate a research and education information exchange throughout the national estuarine research reserve system. As part of this role, NOAA will ensure that information and ideas from one reserve are made available to others in the system. The network will enable reserves to exchange information and research data with each other, with universities engaged in estuarine research, and with Federal and state agencies. NOAA's objective is a system-wide program of research and monitoring capable of addressing the management issues that affect long-term productivity of our Nation's estuaries.

§ 921.2 Definitions.

(a) *Act* means the Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 *et seq.* Section 315 of the Act, 16 U.S.C. 1461, establishes the National Estuarine Reserve Research System.

(b) *Under Secretary* means the Under Secretary for Oceans and Atmosphere, U.S. Department of Commerce, or designee.

(c) *Coastal state* means a state of the United States, in or bordering on, the Atlantic, Pacific, or Arctic Ocean; the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes. For the purposes of these regulations the term also includes Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territories of the Pacific Islands, and American Samoa (see 16 U.S.C. 1453(4)).

(d) *Estuary* means that part of a river or stream or other body of water having

unimpaired connection with the open sea, where the sea water is measurably diluted with fresh water derived from land drainage. The term also includes estuary-type areas with measurable freshwater influence and having unimpaired connections with the open sea, and estuary-type areas of the Great Lakes and their connecting waters. See 16 U.S.C. 1453(7)).

(e) *National Estuarine Research Reserve* means an area that is a representative estuarine ecosystem suitable for long-term research, which may include all or the key land and water portion of an estuary, and adjacent transitional areas and uplands constituting to the extent feasible a natural unit, and which is set aside as a natural field laboratory to provide long-term opportunities for research, education, and interpretation on the ecological relationships within the area (see 16 U.S.C. 1453(8)) and meets the requirements of 16 U.S.C. 1461(b). This includes those areas designated as national estuarine sanctuaries under section 315 of the Act prior to the date of the enactment of the Coastal Zone Management Reauthorization Act of 1985 and each area subsequently designated as a national estuarine research reserve.

§ 921.3 National Estuarine Reserve Research System biogeographic classification scheme and estuarine typologies.

(a) National estuarine research reserves are chosen to reflect regional differences and to include a variety of ecosystem types. A biogeographic classification scheme based on regional variations in the nation's coastal zone has been developed. The biogeographic classification scheme is used to ensure that the National Estuarine Reserve Research System includes at least one site from each region. The estuarine typology system is utilized to ensure that sites in the System reflect the wide range of estuarine types within the United States.

(b) The biogeographic classification scheme, presented in Appendix I to this part, contains 27 regions. Figure 2 graphically depicts the biogeographic regions of the United States.

(c) The typology system is presented in Appendix II to this part.

§ 921.4 Relationship to other provisions of the Coastal Zone Management Act.

(a) The National Estuarine Reserve Research System is intended to provide information to state agencies and other entities involved in addressing coastal management issues. Any coastal state, including those that do not have approved coastal zone management programs under section 306 of the Act, is eligible for an award under the National Estuarine Reserve Research System (see § 921.2(c)).

(b) For purposes of consistency review by states with a federally approved coastal zone management program, the designation of a national estuarine research reserve is deemed to be a Federal activity, which, if directly affecting the state's coastal zone, must be undertaken in a manner consistent to the maximum extent practicable with the approved state coastal zone program as provided by section 1456(c)(1) of the Act, and implementing regulations at 15 CFR part 930, subpart C. In accordance with section 1456(c)(1) of the Act and the applicable regulations NOAA will be responsible for certifying that designation of the reserve is consistent with the State approved coastal zone management program. The State must concur with or object to the certification. It is recommended that the lead State agency for reserve designation consult at the earliest practicable time, with the appropriate State officials concerning the consistency of the proposed national estuarine research reserve.

(c) The National Estuarine Research Reserve Program will be administered in close coordination with the National Marine Sanctuary Program (Title III of the Marine Protection Research and Sanctuaries Act, as amended, 16 U.S.C. 1431–1445), also administered by NOAA. Title III authorizes the Secretary of Commerce to designate discrete areas of the marine environment as marine sanctuaries to protect or restore such areas for their conservation, recreational, ecological, historical, research, educational or esthetic values. National marine sanctuaries and estuarine research reserves may not overlap, though they may be adjacent.

Subpart B—Site Selection, Post Site Selection and Management Plan Development

§ 921.10 General.

(a) A state may apply for Federal financial assistance for the purpose of site selection, preparation of documents specified in § 921.13 (draft management plan and environmental impact statement (EIS)) and the conduct of research necessary to complete basic characterization studies. The total Federal share of this group of predesignation awards may not exceed $100,000, of which up to $25,000 may be used for site selection as described in § 921.11. Federal financial assistance for preacquisition activities under § 921.11 and § 921.12 is subject to the total $4 million for which each reserve is eligible for land acquisition. In the case of a biogeographic region (see Appendix I to this part) shared by two or more states, each state is eligible for Federal financial assistance to establish a national estuarine research reserve within their respective portion of the shared biogeographic region. Financial assistance application procedures are specified in subpart I of this part.

(b) In developing a research reserve program, a state may choose to develop a multiple-site research reserve reflecting a diversity of habitats in a single biogeographic region. A multiple-site research reserve also allows the state to develop complementary research and educational programs within the individual components of its multi-site research reserve. Multiple-site research reserves are treated as one reserve in terms of financial assistance and development of an overall management framework and plan. Each individual site of a proposed multiple-site research reserve shall be evaluated both separately under § 921.11(c) and collectively as part of the site selection process. A state may propose to establish a multiple-site research reserve at the time of the initial site selection, or at any point in the development or operation of the estuarine research reserve, even after Federal funding for the single site research reserve has expired. If the state decides to develop a multiple-site national estuarine research reserve after the initial acquisition and development award is made for a single site, the proposal is subject to the requirements set forth in § 921.33(b). However, a state may not propose to add one or more sites to an already designated research reserve if the operation and management of such research reserve has been found deficient and uncorrected or the research conducted not consistent with the Estuarine Research Guidelines in accordance with the provisions of subparts E and F of this part. In addition, Federal funds acquisition of a multiple-site research reserve remains limited to $4,000,000 (see § 921.20). The funding for operation of a multiple-site research reserve is limited to $70,000 per year (see § 921.32(c)) and preacquisition funds are limited to $100,000 per reserve.

§ 921.11 Site selection.

(a) A state may use up to $25,000 in Federal funds to establish and implement a site selection process which is approved by NOAA.

(b) In addition to the requirements set forth in subpart I of this part, a request

for Federal funds for site selection must contain the following programmatic information:

(1) A description of the proposed site selection process and how it will be implemented in conformance with the biogeographic classification scheme and typology (§ 921.3);

(2) An identification of the site selection agency and the potential management agency; and

(3) A description of how public participation will be incorporated into the process (see § 921.11(d)).

(c) As part of the site selection process, the state and NOAA shall evaluate and select the final site(s). NOAA has final authority in approving such sites. Site selection shall be guided by the following principles:

(1) The site's contribution to the biogeographical and typological balance of the National Estuarine Reserve Research System. NOAA will give priority consideration to proposals to establish reserves in biogeographic regions or subregions that are not represented in the system (see the biogeographic classification scheme and typology set forth in § 921.3 and appendices I and II to this part);

(2) The site's ecological characteristics, including its biological productivity, diversity of flora and fauna, and capacity to attract a broad range of research and educational interests. The proposed site must be a representative estuarine ecosystem and should, to the maximum extent possible, be an estuarine ecosystem minimally affected by human activity or influence (see § 921.1(e));

(3) Assurance that the site's boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Boundary size will vary greatly depending on the nature of the ecosystem. Research reserve boundaries must encompass the area within which adequate control has or will be established by the managing entity over human activities occurring within the reserve. Generally, reserve boundaries will encompass two areas: key land and water areas (or "core area") and a buffer zone. Key land and water areas and a buffer zone will likely require significantly different levels of control (see § 921.13(a)(7)). The term "key land and water areas" refers to that core area within the reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to ensure the long-term viability of the reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are "key" to a particular reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the reserve. The term "buffer zone" refers to an area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. National estuarine research reserves may include existing Federal or state lands already in a protected status where mutual benefit can be enhanced. However, NOAA will not approve a site for potential national estuarine research reserve status that is dependent primarily upon the inclusion of currently protected Federal lands in order to meet the requirements for research reserve status (such as key land and water areas). Such lands generally will be included within a research reserve to serve as a buffer or for other ancillary purposes;

(4) The site's suitability for long-term estuarine research, including ecological factors and proximity to existing research facilities and educational institutions;

(5) The site's compatibility with existing and potential land and water uses in contiguous areas as well as approved coastal and estuarine management plans; and

(6) The site's importance to education and interpretive efforts, consistent with the need for continued protection of the natural system.

(d) Early in the site selection process the state must seek the views of affected landowners, local governments, other state and Federal agencies and other parties who are interested in the area(s) being considered for selection as a potential national estuarine research reserve. After the local government(s) and affected landowner(s) have been contacted, at least one public meeting shall be held in the area of the proposed site. Notice of such a meeting, including the time, place, and relevant subject matter, shall be announced by the state through the area's principal news media at least 15 days prior to the date of the meeting and by NOAA in the Federal Register.

(e) A state request for NOAA approval of a proposed site (or sites in the case of a multi-site reserve) must contain a description of the proposed site in relationship to each of the site selection principles (§ 921.11(c)) and the following information:

(1) An analysis of the proposed site based on the biogeographical scheme/typology discussed in § 921.3 and set forth in appendices I and II to this part;

(2) A description of the proposed site and its major resources, including location, proposed boundaries, and adjacent land uses. Maps, including aerial photographs, are required;

(3) A description of the public participation process used by the state to solicit the views of interested parties, a summary of comments, and, if interstate issues are involved, documentation that the Governor(s) of the other affected state(s) has been contacted. Copies of all correspondence, including contact letters to all affected landowners must be appended;

(4) A list of all sites considered and a brief statement of the basis for not selecting the non-preferred sites; and

(5) A nomination of the proposed site(s) for designation as a National Estuarine Research Reserve by the Governor of the coastal state in which the area is located.

§ 921.12 Post site selection.

(a) At the time of the state's request for NOAA approval of a proposed site, the state may submit a request for up to $40,000 of the total $100,000 allowed for predesignation funds to develop the draft management plan and for the collection of the information necessary for preparation of the environmental impact statement. At this time, the state may also submit a request for the remainder of the predesignation funds for research necessary to complete a basic characterization of the physical, chemical and biological characteristics of the site approved by NOAA. The state's request for these post site selection funds must be accompanied by the information specified in subpart I of this part and, for draft management plan

development and environmental impact statement information collection, the following programmatic information:

(1) A draft management plan outline (see § 921.13(a) below); and

(2) An outline of a draft memorandum of understanding (MOU) between the state and NOAA detailing the Federal-state role in research reserve management during the initial period of Federal funding and expressing the state's long-term commitment to operate and manage the national estuarine research reserve.

(b) The state is eligible to use the funds referenced in § 921.12(a) after the proposed site is approved by NOAA under the terms of § 921.11.

§ 921.13 Management plan and environmental impact statement development.

(a) After NOAA approves the state's proposed site, the state may request to use additional predesignation funds for draft management plan development and the collection of information necessary for the preparation by NOAA of the environmental impact statement. The state shall develop a draft management plan, including an MOU. The plan will set out in detail:

(1) Research reserve goals and objectives, management issues, and strategies or actions for meeting the goals and objectives;

(2) An administrative section including staff roles in administration, research, education/interpretation, and surveillance and enforcement;

(3) A research plan, including a monitoring design;

(4) An education/interpretive plan;

(5) A plan for public access to the research reserve;

(6) A construction plan, including a proposed construction schedule, general descriptions of proposed developments and preliminary drawings, if appropriate. Information should be provided for proposed minor construction projects in sufficient detail to allow these projects to begin in the initial phase of acquisition and development. If a visitor center, research center or any other facilities are proposed for construction or renovation at the site, or restorative activities which require significant construction are planned, a detailed construction plan including preliminary cost estimates and architectural drawings must be prepared as a part of the final management plan; and

(7) An acquisition plan identifying the ecologically key land and water areas of the research reserve, ranking these areas according to their relative importance, and including a strategy for establishing adequate long-term state control over these areas sufficient to provide protection for reserve resources to ensure a stable environment for research. This plan must include an identification of ownership within the proposed research reserve boundaries, including land already in the public domain; the method(s) of acquisition which the state proposes to use—acquisition (including less-than-fee simple options) to establish adequate long-term state control; an estimate of the fair market value of any property interest—which is proposed for acquisition; a schedule estimating the time required to complete the process of establishing adequate state control of the proposed research reserve; and a discussion of any anticipated problems. In selecting a preferred method(s) for establishing adequate state control over areas within the proposed boundaries of the reserve, the state shall perform the following steps for each parcel determined to be part of the key land and water areas (control over which is necessary to protect the integrity of the reserve for research purposes), and for those parcels required for research and interpretive support facilities or buffer purposes:

(i) Determine, with appropriate justification, the minimum level of control(s) required (*e.g.*, management agreement, regulation, less-than-fee simple property interest (*e.g.*, conservation easement), fee simple property acquisition, or a combination of these approaches;

(ii) Identify the level of existing state control(s);

(iii) Identify the level of additional state control(s), if any, necessary to meet the minimum requirements identified in (a)(7)(i); of this section;

(iv) Examine all reasonable alternatives for attaining the level of control identified in (a)(7)(iii) of this section, and perform a cost analysis of each; and

(v) Rank, in order of cost, the methods (including acquisition) identified in paragraph (a)(7)(iv) of this section.

An assessment of the relative cost-effectiveness of control alternatives shall include a reasonable estimate of both short-term costs (*e.g.*, acquisition of property interests, regulatory program development including associated enforcement costs, negotiation, adjudication, etc.) and long-term costs (*e.g.*, monitoring, enforcement, adjudication, management and coordination). In selecting a preferred method(s) for establishing adequate state control over each parcel examined under the process described above, the state shall give priority consideration to the least costly method(s) of attaining the minimum level of long-term control required. Generally, with the possible exception of buffer areas required for support facilities, the level of control(s) required for buffer areas will be considerably less than that required for key land and water areas. This acquisition plan, after receiving the approval of NOAA, shall serve as a guide for negotiations with landowners. A final boundary for the reserve shall be delineated as a part of the final management plan;

(8) A resource protection plan detailing applicable authorities, including allowable uses, uses requiring a permit and permit requirements, any restrictions on use of the research reserve, and a strategy for research reserve surveillance and enforcement of such use restrictions, including appropriate government enforcement agencies;

(9) If applicable, a restoration plan describing those portions of the site that may require habitat modification to restore natural conditions;

(10) A proposed memorandum of understanding (MOU) between the state and NOAA regarding the Federal-state relationship during the establishment and development of the national estuarine research reserve, and expressing a long-term commitment by the state to maintain and manage the research reserve in accordance with section 315 of the Act 16 U.S.C. 1461, and applicable regulations. In conjunction with the MOU and where possible under state law, the state will consider taking appropriate administrative or legislative action to ensure the long-term protection and operation of the national estuarine research reserve. The MOU shall be signed prior to research reserve designation. If other MOUs are necessary (such as with a Federal agency or another state agency), drafts of such MOUs also must be included in the plan; and

(11) If the state has a federally approved coastal zone management program, documentation that the proposed national estuarine research reserve is consistent to the maximum extent practicable with that program. See § 921.4(b) and § 921.30(b).

(b) Regarding the preparation of an environmental impact statement (EIS) under the National Environmental Policy Act on a national estuarine research reserve proposal, the state shall provide all necessary information to NOAA concerning the socioeconomic and environmental impacts associated with

implementing the draft management plan and feasible alternatives to the plan. Based on this information, NOAA will prepare the draft EIS.

(c) Early in the development of the draft management plan and the draft EIS, the state shall hold a meeting in the area or areas most affected to solicit public and government comments on the significant issues related to the proposed action. NOAA will publish a notice of the meeting in the Federal Register 15 days prior to the meeting. The state shall be responsible for publishing a similar notice in the local media.

(d) NOAA will publish a Federal Register notice of intent to prepare a draft EIS. After the draft EIS is prepared and filed with the Environmental Protection Agency (EPA), a Notice of Availability of the DEIS will appear in the Federal Register. Not less than 30 days after publication of the notice, NOAA will hold at least one public hearing in the area or areas most affected by the proposed national estuarine research reserve. The hearing will be held no sooner than 15 days after appropriate notice of the meeting has been given in the principal news media and in the Federal Register by NOAA and the state, respectively. After a 45-day comment period, a final EIS will be prepared by NOAA.

Subpart C—Acquisition, Development, and Preparation of the Final Management Plan

§ 921.20 General.

The acquisition and development period is separated into two major phases. After NOAA approval of the site, draft management plan and draft MOU, and completion of the final EIS, a state is eligible for an initial acquisition and development award(s). In this initial phase, the state should work to meet the criteria required for formal research reserve designation; *e.g.*, establishing adequate state control over the key land and water areas as specified in the draft management plan and preparing the final management plan. These requirements are specified in § 921.30. Minor construction in accordance with the draft management plan may also be conducted during this initial phase. The initial acquisition and development phase is expected to last no longer than three years. If necessary, a longer time period may be negotiated between the state and NOAA. After research reserve designation, a state is eligible for a supplemental acquisition and development award(s) in accordance with § 921.31. In this post-designation acquisition and development phase, funds may be used in accordance with the final management plan to construct research and educational facilities, complete any remaining land acquisition, and for restorative activities identified in the final management plan. In any case, the amount of Federal financial assistance provided to a coastal state with respect to the acquisition of lands and waters, or interests therein, for any one national estuarine research reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein or $4,000,000, whichever amount is less. The amount of Federal assistance for development and construction activities is $1,500,000.

§ 921.21 Initial acquisition and development awards.

(a) Assistance is provided to aid the recipient in:

(1) Acquiring a fee simple or less-than-fee simple real property interest in land and water areas to be included in the research reserve boundaries (see § 921.13(a)(7); § 921.30(d));

(2) Minor construction, as provided in paragraphs (b) and (c) of this section;

(3) Preparing the final management plan; and

(4) Up to the point of research reserve designation, initial management costs, *e.g.*, for implementing the NOAA approved draft management plan, preparing the final management plan, hiring a reserve manager and other staff as necessary and for other management-related activities. Application procedures are specified in subpart I of this part.

(b) The expenditure of Federal and state funds on major construction activities is not allowed during the initial acquisition and development phase. The preparation of architectural and engineering plans, including specifications, for any proposed construction, or for proposed restorative activities, is permitted. In addition, minor construction activities, consistent with paragraph (c) of this section also are allowed. The NOAA-approved draft management plan must, however, include a construction plan and a public access plan before any award funds can be spent on construction activities.

(c) Only minor construction activities that aid in implementing portions of the management plan (such as boat ramps and nature trails) are permitted during the initial acquisition and development phase. No more than five (5) percent of the initial acquisition and development award may be expended on such facilities. NOAA must make a specific determination, based on the final EIS, that the construction activity will not be detrimental to the environment.

(d) Except as specifically provided in paragraphs (a) through (c) of this section, construction projects, to be funded in whole or in part under an acquisition and development award(s), may not be initiated until the research reserve receives formal designation (see § 921.30). This requirement has been adopted to ensure that substantial progress in establishing adequate state control over key land and waters areas has been made and that a final management plan is completed before major sums are spent on construction. Once substantial progress in establishing adequate state control/acquisition has been made, as defined by the state in the management plan, other activities guided by the final management plan may begin with NOAA's approval.

(e) For any real property acquired in whole or part with Federal funds for the research reserve the state shall execute suitable title documents to include substantially the following provisions, or otherwise append the following provisions in a manner acceptable under applicable state law to the official land record(s):

(1) Title to the property conveyed by this deed shall vest in the [recipient of the award granted pursuant to section 315 of the Act, 16 U.S.C. 1461 or other NOAA approved state agency] subject to the condition that the designation of the [name of National Estuarine Reserve] is not withdrawn and the property remains part of the federally designated [name of National Estuarine Research Reserve].

(2) In the event that the property is no longer included as part of the research reserve, or if the designation of the research reserve of which it is part is withdrawn, then NOAA or its successor agency, after full and reasonable consultation with the State, may exercise the following rights regarding the disposition of the property:

(i) The recipient may retain title after paying the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the current fair market value of the property;

(ii) If the recipient does not elect to retain title, the Federal Government may either direct the recipient to sell the property and pay the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the proceeds from the sale (after deducting actual and reasonable

selling and repair or renovation expenses, if any, from the sale proceeds), or direct the recipient to transfer title to the Federal Government. If directed to transfer title to the Federal Government, the recipient shall be entitled to compensation computed by applying the recipient's percentage of participation in the cost of the original project to the current fair market value of the property;

(iii) Fair market value of the property must be determined by an independent appraiser and certified by a responsible official of the state, as provided by Department of Commerce Regulations in 15 CFR part 24, and Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally assisted programs in 15 CFR part 11.

(f) Upon instruction by NOAA, provisions analogous to those of § 921.21(e) shall be included in the documentation underlying less-than-fee-simple interests acquired in whole or part with Federal funds.

(g) Federal funds or non-Federal matching share funds shall not be spent to acquire a real property interest in which the State will own the land concurrently with another entity unless the property interest has been identified as a part of an acquisition strategy pursuant to § 921.13(7) which has been approved by NOAA prior to the effective date of these regulations.

(h) Prior to submitting the final management plan to NOAA for review and approval, the state shall hold a public meeting to receive comment on the plan in the area affected by the estuarine research reserve. NOAA will publish a notice of the meeting in the Federal Register. The state shall be responsible for having a similar notice published in the local media.

Subpart D—Reserve Designation and Subsequent Operation

§ 921.30 Designation of National Estuarine Research Reserves.

(a) The Under Secretary may designate an area as a national estuarine research reserve pursuant to section 315 of the Act, if based on written findings the state has met the following requirements:

(1) The Governor of the coastal state in which the area is located has nominated the area for designation as a national estuarine research reserve;

(2) The area is a representative estuarine ecosystem that is suitable for long-term research and contributes to the biogeographical and typological balance of the System;

(3) Key land and water areas of the proposed research reserve, as identified in the management plan, are under adequate state control sufficient to provide long-term protection for reserve resources and to ensure a stable environment for research;

(4) Designation of the area as a reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation;

(5) A final management plan has been approved by NOAA and contains the signed copy of the designation findings;

(6) An MOU has been signed between the state and NOAA ensuring a long-term commitment by the state to the effective operation and implementation of the national estuarine research reserve; and

(7) The coastal state in which the area is located has complied with the requirements of these regulations.

(b) NOAA will determine whether the designation of a national estuarine research reserve in a state with a federally approved coastal zone management program directly affects the coastal zone. If the designation is found to directly affect the coastal zone, NOAA will make a consistency determination pursuant to section 307(c)(1) of the Act, 16 U.S.C. 1456, and 15 CFR part 930, subpart C. See § 921.4(b). The results of this consistency determination will be published in the Federal Register when a notice of designation is published. See § 921.30(c).

(c) NOAA will cause a notice of designation of a national estuarine research reserve to be placed in the Federal Register. The state shall be responsible for having a similar notice published in the local media.

(d) The term "state control" in § 921.30(a)(3) does not necessarily require that key land and water areas be owned by the state in *fee simple*. Acquisition of less-than-fee-simple interests (*e.g.*, conservation easements) and utilization of existing State regulatory measures are encouraged where the state can demonstrate that these interests and measures assure adequate long-term State control consistent with the purposes of the research reserve (see also § 921.13(a)(7); § 921.21(g)). Should the state later elect to purchase an interest in such lands using NOAA funds, adequate justification as to the need for such acquisition must be provided to NOAA.

§ 921.31 Supplemental acquisition and development awards.

After national estuarine research reserve designation, and as specified in the approved management plan, the state may request a supplemental acquisition and/or development award(s) for acquiring additional property interests identified in the management plan as necessary to enhance long-term protection of the area for research and education, for facility construction, for restorative activities identified in the approved management plan, and for administrative purposes. The amount of Federal financial assistance provided for supplemental development costs directly associated with facility construction other than land acquisition (*i.e.*, major construction activities) for any one national estuarine research reserve may not exceed $1,500,000 and must be matched by the state on a 50/50 basis. Supplemental acquisition awards for the acquisition of lands or waters, or interests therein, for any one National Estuarine Reserve may not exceed an amount equal to 50 per centum of the cost of the lands, waters, and interests therein or $4,000,000 whichever amount is less. In the case of a biogeographic region (see Appendix I to this part) shared by two or more states, each state is eligible for Federal financial assistance to establish a national estuarine research reserve within their respective portion of the shared biogeographic region. Application procedures are specified in subpart I of this part. Land acquisition must follow the procedures specified in § 921.13(a)(7), § 921.21 (e) and (f) and § 921.81.

§ 921.32 Operation and management: Implementation of the management plan.

(a) After the national estuarine research reserve is formally designated the state is eligible to receive Federal funds to assist the state in the operation and management of the research reserve. The purpose of this Federally funded operation and management phase is to implement the approved final management plan and to take the necessary steps to ensure the continued effective operation of the research reserve.

(b) State operation and management of national estuarine research reserves shall be consistent with the mission, and shall further the goals, of the National Estuarine Research Reserve System (see § 921.1).

(c) Federal funds of up to $70,000 per year, to be matched by the state on a 50/50 basis, are available for the operation and management of the national estuarine research reserve, including the establishment and operation of a basic environmental monitoring program. In the case of a biogeographic region (see appendix I to

this part) shared by two or more states, each state is eligible for Federal financial assistance to establish a national estuarine research reserve within their respective portion of the shared biogeographic region (see § 921.10).

(d) Operation and management funds are subject to the following limitations:

(1) No more than $70,000 in Federal funds may be expended in a twelve month award period (*i.e.*, Federal funds for operation and management may not be expended at a rate greater than $70,000 per year);

(2) No more than ten percent of the total amount (state and Federal shares) of each operation and management award may be used for construction-type activities (*i.e.*, $14,000 maximum per year).

§ 921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.

(a) Changes in research reserve boundaries and major changes to the final management plan, including state laws or regulations promulgated specifically for the research reserve, may be made only after written approval by NOAA. If determined to be necessary, NOAA may require public notice, including notice in the Federal Register and an opportunity for public comment. Changes in the boundaries of the research reserve involving the acquisition of properties not listed in the management plan or final EIS require public notice and the opportunity for comment; in certain cases, an environmental assessment and possibly, an environmental impact statement, may be required. Where public notice is required, NOAA will place a notice in the Federal Register of any proposed changes in research reserve boundaries or proposed major changes to the final management plan. The state shall be responsible for publishing an equivalent notice in the local media. See also requirements of § 921.4(b) and § 921.13(a)(11).

(b) As discussed in § 921.10(b), a state may choose to develop a multiple-site national estuarine research reserve after the initial acquisition and development award for a single site has been made. Public notice of the proposed addition will be placed by NOAA in the Federal Register. The state shall be responsible for publishing an equivalent notice in the local media. An opportunity for comment, in addition to the preparation of either an environmental assessment or environmental impact statement on the proposal, will also be required. An environmental impact statement, if required, shall be prepared in accordance with section § 921.13 and shall include an administrative framework for the multiple-site research reserve and a description of the complementary research and educational programs within the research reserve. If NOAA determines, based on the scope of the project and the issues associated with the additional site, that an environmental assessment is sufficient to establish a multiple-site research reserve, then the state shall develop a revised management plan which, concerning the additional component, incorporates each of the elements described in § 921.13(a). The revised management plan shall address goals and objectives for all components of the multi-site research reserve and the additional component's relationship to the original site(s).

Subpart E—Performance Evaluation and Withdrawal of Designation

§ 921.40 Evaluation of system performance.

(a) Following designation of a national estuarine research reserve pursuant to § 921.30, periodic performance evaluations shall be conducted concerning the operation and management of each national estuarine research reserve, including the research and monitoring being conducted within the reserve and education and interpretive activities. Evaluations may assess performance in all aspects of research reserve operation and management or may be limited in scope, focusing on selected issues of importance. Performance evaluations in assessing research reserve operation and management may also examine whether a research reserve is in compliance with the requirements of these regulations, particularly whether:

(1) The operation and management of the research reserve is consistent with and furthers the mission and goals of the National Estuarine Reserve Research System (see § 921.1); and

(2) A basis continues to exist to support any one or more of the findings made under § 921.30(a).

(b) Generally, performance will be evaluated at least every three years. More frequent evaluations may be scheduled as determined to be necessary by NOAA.

(c) Performance evaluations will be conducted by Federal officials. When determined to be necessary, Federal and non-Federal experts in natural resource management, estuarine research, interpretation or other aspects of national estuarine research reserve operation and management may be requested by NOAA to participate in performance evaluations. If other experts are to be included in the evaluation, NOAA will first ask the state to recommend appropriate individuals to serve in that capacity.

(d) Performance evaluations will be conducted in accordance with the procedural and public participation provisions of the CZMA regulations on review of performance at 15 CFR part 928 (*i.e.*, § 928.3(b) and § 928.4).

(e) To ensure effective Federal oversight of each research reserve within the National Estuarine Reserve Research System the state is required to submit an annual report on operation and management of the research reserve during the immediately preceding state fiscal year. This annual report must be submitted within a ninety day period following the end of the state fiscal year. The report shall detail program successes and accomplishments, referencing the research reserve management plan and, as appropriate, the work plan for the previous year. A work plan, detailing the projects and activities to be undertaken over the coming year to meet the goals and objectives of the research reserve as described in the management plan and the state's role in ongoing research reserve programs, shall also be included.

§ 921.41 Suspension of eligibility for financial assistance.

(a) If a performance evaluation under § 921.40 reveals that the operation and management of the research reserve is deficient, or that the research being conducted within the reserve is not consistent with the Estuarine Research Guidelines referenced in subpart F of this part, the eligibility of the research reserve for Federal financial assistance as described in these regulations may be suspended until the deficiency or inconsistency is remedied.

(b) NOAA will provide the state with a written notice of the deficiency or inconsistency. This notice will explain the finding, assess the Federal role in contributing to the problem, propose a solution or solutions, provide a schedule by which the state should remedy the deficiency or inconsistency, and state whether the state's eligibility for Federal financial assistance has been suspended in whole or part. In this notice the state shall also be advised that it may comment on this finding and meet with NOAA officials to discuss the results of the performance evaluation and seek to remedy the deficiency or inconsistency.

(c) Eligibility of a research reserve for financial assistance under these regulations shall be restored upon written notice by NOAA to the state

that the deficiency or inconsistency has been remedied.

(d) If, after a reasonable time, a state does not remedy a deficiency in the operation and management of a national estuarine research reserve which has been identified pursuant to a performance evaluation under § 921.40(a), such outstanding deficiency shall be considered a basis for withdrawal of designation (see § 921.42).

§ 921.42 Withdrawal of designation.

(a) Designation of an estuarine area as a national estuarine research reserve may be withdrawn if a performance evaluation conducted pursuant to § 921.40 reveals that:

(1) The basis for any one or more of the findings made under § 921.30(a) in designating the research reserve no longer exists;

(2) A substantial portion of the research conducted within the research reserve, over a period of years, has not been consistent with the Estuarine Research Guidelines referenced in subpart F of this part; or

(3) A state, after a reasonable time, has not remedied a deficiency in the operation and management of a research reserve identified pursuant to an earlier performance evaluation conducted under § 921.40.

(b) If a basis is found under § 921.42(a) for withdrawal of designation, NOAA will provide the state with a written notice of this finding. This notice will explain the basis for the finding, propose a solution or solutions and provide a schedule by which the state should correct the deficiency. In this notice, the state shall also be advised that it may comment on the finding and meet with NOAA officials to discuss the finding and seek to correct the deficiency.

(c) If, within a reasonable period of time, the deficiency is not corrected in a manner acceptable to NOAA, a notice of intent to withdraw designation, with an opportunity for comment, will be placed in the Federal Register.

(d) The state shall be provided the opportunity for an informal hearing before the Under Secretary to consider NOAA's finding of deficiency and intent to withdraw designation, as well as the state's comments on and response to NOAA's written notice pursuant to § 921.42(b) and Federal Register notice pursuant to § 921.42(c).

(e) Within 30 days after the informal hearing, the Under Secretary shall issue a written decision regarding the designation status of the national estuarine research reserve. If a decision is made to withdraw research reserve designation, the procedures specified in § 921.21(e) regarding the disposition of real property acquired in whole or part with Federal funds shall be followed.

(f) NOAA may not withdraw designation of a national estuarine research reserve if the performance evaluation reveals that the deficiencies in management of the site are a result of inadequate Federal financial support.

Subpart F—Research

§ 921.50 General.

(a) To stimulate high quality research within designated national estuarine research reserves, NOAA may provide financial support for research which is consistent with the Estuarine Research Guidelines referenced in § 921.51. Research awards may be awarded under this subpart to only those designated research reserves with approved final management plans with the following exception: NOAA may award research awards under this subpart to reserves without final management plans that have been designated prior to the effective date of these regulations; in the absence of an approved final management plan, however these reserves will be eligible for research awards during only the first two years after the effective date of these regulations. Although this research may be conducted within the immediate watershed of the research reserve, the majority of research activities of any single research project funded under this subpart must be conducted within reserve boundaries. Research funds are primarily used to support management-related research that will enhance scientific understanding of the research reserve ecosystem, provide information needed by reserve managers and coastal management decision-makers, and improve public awareness and understanding of estuarine ecosystems and estuarine management issues. Research projects may be oriented to specific research reserves; however, research projects that would benefit more than one research reserve in the National Estuarine Reserve Research System are encouraged.

(b) Federal research funds under this subpart are not intended as a source of continuous funding for a particular project over time. Research funds may be used to support start-up costs for long-term projects if an applicant can identify an alternative source of long-term research support.

(c) Research funds are available on a competitive basis to any coastal state or qualified public or private person. A notice of available funds will be published in the Federal Register. Research funds are provided in addition to any other funds available to a coastal state under the Act. Federal research funds provided under this subpart must be matched equally by the recipient, consistent with § 921.81(e)(4) ("allowable costs").

§ 921.51 Estuarine research guidelines.

(a) Research within the National Estuarine Reserve Research System shall be conducted in a manner consistent with Estuarine Research Guidelines developed by NOAA.

(b) A summary of the Estuarine Research Guidelines is published in the Federal Register as a part of the notice of available funds discussed in § 921.50(c).

(c) The Estuarine Research Guideline are reviewed annually by NOAA. This review will include an opportunity for comment by the estuarine research community.

§ 921.52 Promotion and coordination of estuarine research.

(a) NOAA will promote and coordinate the use of the National Estuarine Reserve Research System for research purposes.

(b) NOAA will, in conducting or supporting estuarine research other than that authorized under section 315 of the Act, give priority consideration to research that uses the National Estuarine Reserve Research System.

(c) NOAA will consult with other Federal and state agencies to promote use of one or more research reserves within the National Estuarine Reserve Research System when such agencies conduct estuarine research.

Subpart G—Monitoring

§ 921.60 General.

(a) To provide a systematic basis for developing a high quality estuarine resource and ecosystem information base for national estuarine research reserves and, as a result, for the System NOAA may provide financial support for monitoring programs. Monitoring funds are used to support three major phases of a monitoring program; studies necessary for comprehensive site description/characterization, development of a site profile, and implementation of a monitoring program.

(b) Monitoring funds are available on a competitive basis to the state agency responsible for reserve management or qualified public or private person or entity designated by the Reserve. However, if the applicant is other than the managing entity of a reserve research (coastal state), that applicant must submit as a part of the application

a letter from the reserve manager indicating formal support of the application by the managing entity of the reserve. Monitoring awards will be made on the basis of a five-year performance period; and with initial funding for a twelve (12) month period; and with annual supplemental funding contingent on performance and appropriations under the Act. Monitoring funds are provided in addition to any other funds available to a coastal state under the Act. Federal monitoring funds must be matched equally by the recipient, consistent with § 921.81(e)(4) ("allowable costs").

(c) Monitoring projects funded under this Subpart must focus on the resources within the boundaries of the research reserve and must be consistent with the applicable sections of the Estuarine Research Guidelines referenced in § 921.51. Portions of the project may occur within the immediate watershed of the Reserve beyond the site boundaries. However, the monitoring proposal must demonstrate why this is necessary for the success of the project.

Subpart H—Interpretation and Education

§ 921.70 General.

(a) To stimulate the development of innovative or creative interpretive and educational projects and materials to enhance public awareness and understanding of estuarine areas, NOAA may fund interpretive and educational activities. Interpretive and educational awards may be awarded under this subpart to only those designated research reserves with approved final management plans with the following exception: NOAA may award research awards under this subpart to reserves without final management plans that have been designated prior to the effective date of these regulations; in the absence of an approved final management plan, however these reserves will be eligible for research awards during only the first two years after the effective date of these regulations.

(b) Educational and interpretive funds are available on a competitive basis to any coastal state entity. However, if the applicant is other than the managing entity of a research reserve, that applicant must submit as a part of the application a letter from the reserve manager indicating formal support of the pplication by the managing entity of the reserve. These funds are provided in addition to any other funds available to a coastal state under the Act. Federal interpretation and educational funds must be matched equally by the recipient, consistent with § 921.81(e)(4) ("allowable costs").

§ 921.71 Categories of potential interpretive and educational projects; evaluation criteria.

(a) Proposals for interpretive or educational projects will be considered under the following categories:

(1) Design, development and distribution/placement of interpretive or educational media (*i.e.*, the development of tangible items, such as exhibits/displays, publications, posters, signs, audio/visuals, computer software and maps which have an educational or interpretive purpose; and techniques for making available or locating information concerning research reserve resources, activities, or issues);

(2) Development and presentation of curricula, workshops, lectures, seminars, and other structured programs or presentations for facility or field use;

(3) Extension/outreach programs; or

(4) Creative and innovative methods and technologies for implementing interpretive or educational projects.

(b) Interpretive and educational projects may be oriented to one or more research reserves or to the entire system. Those projects which would directly benefit more than one research reserve, and, if practicable, the entire National Estuarine Reserve Research System, shall receive priority consideration for funding.

(c) Proposals for interpretive and educational projects in national estuarine research reserves will be evaluated in accordance with criteria listed below:

(1) Educational or interpretive merits;

(2) Relevance or importance to reserve management or coastal decisionmaking;

(3) Educational quality (*e.g.*, soundness of approach, experience related to methodologies);

(4) Importance to the National Estuarine Reserve Research System;

(5) Budget and Institutional Capabilities (*e.g.*, reasonableness of budget, sufficiency of logistical support); and

(6) In addition, in the case of long-term projects, the ability of the state or the grant recipient to support the project beyond this initial funding.

Subpart I—General Financial Assistance Provisions

§ 921.80 Application information.

(a) Only a coastal state may apply for Federal financial assistance awards for preacquisition, acquisition and development, operation and management, and education and interpretation. Any coastal state or public or private person may apply for Federal financial assistance awards for estuarine research or monitoring. The announcement of opportunities to conduct research in the reserve system appears on an annual basis in the Federal Register. If a state is participating in the national Coastal Zone Management Program, the applicant for an award under section 315 of the Act shall notify the state coastal management agency regarding the application.

(b) An original and two copies of the formal application must be submitted at least 120 working days prior to the proposed beginning of the project to the following address: Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration, Universal Building South, 1825 Connecticut Avenue, NW., Suite 714, Washington, DC 20235. The Application for Federal Assistance Standard Form 424 (Non-construction Program) constitutes the formal application for site selection, post-site selection, operation and management, research, and education and interpretive awards. The Application for Federal Financial Assistance Standard Form 424 (Construction Program) constitutes the formal application for land acquisition and development awards. The application must be accompanied by the information required in subpart B (predesignation) of this part, subpart C of this part and § 921.31 (acquisition and development), and § 921.32 (operation and management) as applicable. Applications for development awards for construction projects, or restorative activities involving construction, must include a preliminary engineering report. All applications must contain back up data for budget estimates (Federal and non-Federal shares), and evidence that the application complies with the Executive Order 12372, "Intergovernmental Review of Federal Programs." In addition, applications for acquisition and development awards must contain:

(1) State Historic Preservation Office comments;

(2) Written approval from NOAA of the draft management plan for initial acquisition and development award(s); and

(3) A preliminary engineering report for construction projects, or restorative activities involving construction.

§ 921.81 Allowable costs.

(a) Allowable costs will be determined in accordance with applicable OMB Circulars and guidance

for Federal financial assistance, the financial assistance agreement, these regulations, and other Department of Commerce and NOAA directives. The term "costs" applies to both the Federal and non-Federal shares.

(b) Costs claimed as charges to the award must be reasonable, beneficial and necessary for the proper and efficient administration of the financial assistance award and must be incurred during the award period.

(c) Costs must not be allocable to or included as a cost of any other Federally-financed program in either the current or a prior award period.

(d) General guidelines for the non-Federal share are contained in Department of Commerce Regulations at 15 CFR part 24 and OMB Circular A-110. Copies of Circular A-110 can be obtained from the Marine and Estuarine Management Division; 1825 Connecticut Avenue, NW., Suite 714; Washington, DC 20235. The following may be used in satisfying the matching requirement:

(1) Site Selection and Post Site Selection Awards. Cash and in-kind contributions (value of goods and services directly benefiting and specifically identifiable to this part of the project) are allowable. Land may not be used as match.

(2) Acquisition and Development Awards. Cash and in-kind contributions are allowable. In general, the fair market value of lands to be included within the research reserve boundaries and acquired pursuant to the Act, with other than Federal funds, may be used as match. However, the fair market value of real property allowable as match is limited to the fair market value of a real property interest equivalent to, or required to attain, the level of control over such land(s) identified by the state and approved by the Federal Government as that necessary for the protection and management of the national estuarine research reserve. Appraisals must be performed accordin to Federal appraisal standards as detailed in Department of Commerce regulations at 15 CFR part 24 and the Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally Assisted Programs in 15 CFR part 11. The fair market value of privately donated land, at the time of donation, as established by an independent appraiser and certified by a responsible official of the state (pursuant to 15 CFR part 24), may also be used as match. Land, including submerged lands already in the state's possession, may be used as match to establish a national estuarine research reserve. The value of match for these state lands will be calculated by determining the value of the benefits foregone by the state, in the use of the land, as a result of new restrictions that may be imposed by Reserve designation. The appraisal of the benefits foregone must be made by an independent appraiser in accordance with Federal appraisal standards pursuant to 15 CFR part 24 and 15 CFR part 11. A state may initially use as match land valued at greater than the Federal share of the acquisition and development award. The value in excess of the amount required as match for the initial award may be used to match subsequent supplemental acquisition and development awards for the national estuarine research reserve (see also § 921.20). Costs related to land acquisition, such as appraisals, legal fees and surveys, may also be used as match.

(3) Operation and Management Awards. Generally, cash and in kind contributions (directly benefiting and specifically identifiable to operations and management), except land, are allowable.

(4) Research, Monitoring, Education and Interpretive Awards. Cash and in-kind contributions (directly benefiting and specifically identifiable to the scope of work), except land, are allowable.

§ 921.82 Amendments to financial assistance awards.

Actions requiring an amendment to the financial assistance award, such as a request for additional Federal funds, revisions of the approved project budget or original scope of work, or extension of the performance period must be submitted to NOAA on Standard Form 424 and approved in writing.

Appendix I to Part 921—Biogeographic Classification Scheme

Acadian

1. Northern Gulf of Maine (Eastport to the Sheepscot River).
2. Southern Gulf of Maine (Sheepscot River to Cape Cod).

Virginian

3. Southern New England (Cape Cod to Sandy Hook).
4. Middle Atlantic (Sandy Hook to Cape Hatteras).
5. Chesapeake Bay.

Carolinian

6. Northern Carolinas (Cape Hatteras to Santee River).
7. South Atlantic (Santee River to St. John's River).
8. East Florida (St. John's River to Cape Canaveral).

West Indian

9. Caribbean (Cape Canaveral to Ft. Jefferson and south).
10. West Florida (Ft. Jefferson to Cedar Key).

Louisianian

11. Panhandle Coast (Cedar Key to Mobile Bay).
12. Mississippi Delta (Mobile Bay to Galveston).
13. Western Gulf (Galveston to Mexican border).

Californian

14. Southern California (Mexican Border to Point Concepcion).
15. Central California (Point Concepcion to Cape Mendocino).
16. San Francisco Bay.

Columbian

17. Middle Pacific (Cape Mendocino to the Columbia River).
18. Washington Coast (Columbia River to Vancouver Island).
19. Puget Sound.

Great Lakes

20. Western Lakes (Superior, Michigan, Huron).
21. Eastern Lakes (Ontario, Erie).

Fjord

22. Southern Alaska (Prince of Wales Island to Cook Inlet).
23. Aleutian Islands (Cook Inlet to Bristol Bay).

Sub-Arctic

24. Northern Alaska (Bristol Bay to Demarcation Point).

Insular

25. Hawaiian Islands.
26. Western Pacific Island.
27. Eastern Pacific Island.

Appendix II to Part 921—Typology of National Estuarine Research Reserves

This typology system reflects significant differences in estuarine characteristics that are not necessarily related to regional location. The purpose of this type of classification is to maximize ecosystem variety in the selection of national estuarine research reserves. Priority will be given to important ecosystem types as yet unrepresented in the reserve system. It should be noted that any one site may represent several ecosystem types or physical characteristics.

Class I—Ecosystem Types

Group I—Shorelands

A. *Maritime Forest-Woodland:* This type of ecosystem consists of single-stemmed species that have developed under the influence of salt spray. It can be found on coastal uplands or recent features, such as barrier islands and beaches, and may be divided into the following biomes:

1. *Northern Coniferous Forest Biome:* This is an area of predominantly evergreens such as the sitka spruce (Picea), grand fir (Abies), and white cedar (Thuja), with poor development of the shrub and herb layers, but high annual productivity and pronounced seasonal periodicity.

2. *Moist Temperate (Mesothermal) Coniferous Forest Biome:* Found along the west coast of North America from California to Alaska, this area is dominated by conifers, has a relatively small seasonal range, high humidity with rainfall ranging from 30 to 150 inches, and a well-developed understory of vegetation with an abundance of mosses and other moisture-tolerant plants.

3. *Temperate Deciduous Forest Biome:* This biome is characterized by abundant, evenly distributed rainfall, moderate temperatures which exhibit a distinct seasonal pattern, well-developed soil biota and herb and shrub layers, and numerous plants which produce pulpy fruits and nuts. A distant subdivision of this biome is the pine edaphic forest of the southeastern coastal plain, in which only a small portion of the area is occupied by climax vegetation, although it has large areas covered by edaphic climax pines.

4. *Broad-leaved Evergreen Subtropical Forest Biomes:* The main characteristic of this biome is high moisture with less pronounced differences between winter and summer. Examples are the hammocks of Florida and the live oak forests of the Gulf and South Atlantic coasts. Floral dominants include pines, magnolias, bays, hollies, wild tamarind, strangler fig, gumbo limbo, and palms.

B. *Coast Shrublands:* This is a transitional area between the coastal grasslands and woodlands and is characterized by woody species with multiple stems a few centimeters to several meters above the ground developing under the influence of salt spray and occasional sand burial. This includes thickets, scrub, scrub savanna, heathlands, and coastal chaparral. There is a great variety of shrubland vegetation exhibiting regional specificity:

1. *Northern Areas:* Characterized by Hudsonia, various ericaceous species, and thickets of Myrica, Prunus, and Rosa.
2. *Southeast Areas:* Floral dominants include Myrica, Baccharis, and Ilex.
3. *Western Areas:* Adenostoma, Arcotyphylos, and Eucalyptus are the dominant floral species.

C. *Coastal Grasslands:* This area, which possesses sand dunes and coastal flats, has low rainfall (10 to 30 inches per year) and large amounts of humus in the soil. Ecological succession is slow, resulting in the presence of a number of serial stages of community development. Dominant vegetation includes mid-grasses (2 to 4 feet tall), such as Ammophila, Agropyron, and Calamovilfa, tall grasses (5 to 8 feet tall), such as Spartina, and trees such as the willow (Salix sp.), cherry (Prunus sp.), and cottonwood (Populus deltoides). This area is divided into four regions with the following typical strand vegetation:

1. Arctic/Boreal: Elymus;
2. Northeast/West: Ammophila;
3. Southeast/Gulf: Uniola; and
4. Mid-Atlantic/Gulf: Spartina patens.

D. *Coastal Tundra:* This ecosystem, which is found along the Arctic and Boreal coasts of North America, is characterized by low temperatures, a short growing season, and some permafrost, producing a low, treeless mat community made up of mosses, lichens, heath, shrubs, grasses, sedges, rushes, and herbaceous and dwarf woody plants. Common species include arctic/alpine plants such as Empetrum nigrum and Betula nana, the lichens Cetraria and Cladonia, and herbaceous plants such as Potentilla tridentata and Rubus chamaemorus. Common species on the coastal beach ridges of the high arctic desert include Dryas intergrifolia and Saxifrage oppositifolia. This area can be divided into two main subdivisions:

1. *Low Tundra:* characterized by a thick, spongy mat of living and undecayed vegetation, often with water and dotted with ponds when not frozen; and

2. *High Tundra:* a bare area except for a scanty growth of lichens and grasses, with underlying ice wedges forming raised polygonal areas.

E. *Coastal Cliffs:* This ecosystem is an important nesting site for many sea and shore birds. It consists of communities of herbaceous, graminoid, or low woody plants (shrubs, heath, etc.) on the top or along rocky faces exposed to salt spray. There is a diversity of plant species including mosses, lichens, liverworts, and "higher" plant representatives.

Group II—Transition Areas

A. *Coastal Marshes:* These are wetland areas dominated by grasses Poacea), sedges (Cyperaceae), rushes (Juncaceae), cattails (Typhaceae), and other graminoid species and is subject to periodic flooding by either salt or freshwater. This ecosystem may be subdivided into: (a) Tidal, which is periodically flooded by either salt or brackish water; (b) non-tidal (freshwater); or (c) tidal freshwater. These are essential habitats for many important estuarine species of fish and invertebrates as well as shorebirds and waterfowl and serves important roles in shore stabilization, flood control, water purification, and nutrient transport and storage.

B. *Coastal Swamps:* These are wet lowland areas that support mosses and shrubs together with large trees such as cypress or gum.

C. *Coastal Mangroves:* This ecosystem experiences regular flooding on either a daily, monthly, or seasonal basis, has low wave action, and is dominated by a variety of salt-tolerant trees, such as the red mangrove (Rhizophora mangle), black mangrove (Avicennia nitida), and the white mangrove (Laguncularia racemosa). It is also an important habitat for large populations of fish, invertebrates, and birds. This type of ecosystem can be found from central Florida to extreme south Texas to the islands of the Western Pacific.

D. *Intertidal Beaches:* This ecosystem has a distinct biota of microscopic animals, bacteria, and unicellular algae along with microscopic crustaceans, mollusks, and worms with a detritus-based nutrient cycle. This area also includes the driftline communities found at high tide levels on the beach. The dominant organisms in this ecosystem include crustaceans such as the mole crab (Emerita), amphipods (Gammaridae), ghost crabs (Ocypode), and bivalve molluscs such as the coquina (Donax) and surf clams (Spisula and Mactra).

E. *Intertidal Mud and Sand Flats:* These areas are composed of unconsolidated, high organic content sediments that function as a short-term storage area for nutrients and organic carbons. Macrophytes are nearly absent in this ecosystem, although it may be heavily colonized by benthic diatoms, dinoflagellates, filamentous blue-green and green algae, and chemosynthetic purple sulfur bacteria. This system may support a considerable population of gastropods, bivalves, and polychaetes, and may serve as a feeding area for a variety of fish and wading birds. In sand, the dominant fauna include the wedge shell Donax, the scallop Pecten, tellin shells Tellina, the heart urchin Echinocardium, the lug worm Arenicola, sand dollar Dendraster, and the sea pansy Renilla. In mud, faunal dominants adapted to low oxygen levels include the terebellid Amphitrite, the boring clam Playdon, the deep sea scallop Placopecten, the quahog Mercenaria, the echiurid worm Urechis, the mud snail Nassarius, and the sea cucumber Thyone.

F. *Intertidal Algal Beds:* These are hard substrates along the marine edge that are dominated by macroscopic algae, usually thalloid, but also filamentous or unicellular in growth form. This also includes the rocky coast tidepools that fall within the intertidal zone. Dominant fauna of these areas are barnacles, mussels, periwinkles, anemones, and chitons. Three regions are apparent:

1. *Northern Latitude Rocky Shores:* It is in this region that the community structure is best developed. The dominant algal species include Chondrus at the low tide level, Fucus and Ascophyllum at the mid-tidal level, and Laminaria and other kelplike algae just beyond the intertidal, although they can be exposed at extremely low tides or found in very deep tidepools.

2. *Southern Latitudes:* The communities in this region are reduced in comparison to those of the northern latitudes and possesses algae consisting mostly of single-celled or filamentous green, blue-green, and red algae, and small thalloid brown algae.

3. *Tropical and Subtropical Latitudes:* The intertidal in this region is very reduced and contains numerous calcareous algae such as Porolithon and Lithothamnion, as well as green algae with calcareous particles such as Halimeda, and numerous other green, red, and brown algae.

Group III—Submerged Bottoms

A. *Subtidal Hardbottoms:* This system is characterized by a consolidated layer of solid rock or large pieces of rock (neither of biotic origin) and is found in association with geomorphological features such as submarine canyons and fjords and is usually covered with assemblages of sponges, sea fans, bivalves, hard corals, tunicates, and other attached organisms. A significant feature of estuaries in many parts of the world is the oyster reef, a type of subtidal hardbottom. Composed of assemblages of organisms (usually bivalves), it is usually found near an estuary's mouth in a zone of moderate wave action, salt content, and turbidity. If light levels are sufficient, a covering of microscopic and attached macroscopic algae, such as kelp, may also be found.

B. *Subtidal Softbottoms:* Major characteristics of this ecosystem are an unconsolidated layer of fine particles of silt, sand, clay, and gravel, high hydrogen sulfide levels, and anaerobic conditions often existing below the surface. Macrophytes are either sparse or absent, although a layer of benthic microalgae may be present if light levels are sufficient. The faunal community is dominated by a diverse population of deposit feeders including polychaetes, bivalves, and burrowing crustaceans.

C. *Subtidal Plants:* This system is found in relatively shallow water (less than 8 to 10 meters) below mean low tide. It is an area of extremely high primary production that provides food and refuge for a diversity of faunal groups, especially juvenile and adult fish, and in some regions, manatees and sea turtles. Along the North Atlantic and Pacific coasts, the seagrass Zostera marina predominates. In the South Atlantic and Gulf coast areas, Thalassia and Diplanthera predominate. The grasses in both areas support a number of epiphytic organisms.

Class II—Physical Characteristics

Group I—Geologic

A. *Basin Type:* Coastal water basins occur in a variety of shapes, sizes, depths, and appearances. The eight basic types discussed below will cover most of the cases:

1. *Exposed Coast:* Solid rock formations or heavy sand deposits characterize exposed ocean shore fronts, which are subject to the full force of ocean storms. The sand beaches are very resilient, although the dunes lying just behind the beaches are fragile and easily damaged. The dunes serve as a sand storage area, making them chief stabilizers of the ocean shorefront.

2. *Sheltered Coast:* Sand or coral barriers, built up by natural forces, provide sheltered areas inside a bar or reef where the ecosystem takes on many characteristics of confined waters—abundant marine grasses, shellfish, and juvenile fish. Water movement is reduced, with the consequent effects of pollution being more severe in this area than in exposed coastal areas.

3. *Bay:* Bays are larger confined bodies of water that are open to the sea and receive strong tidal flow. When stratification is pronounced, the flushing action is augmented by river discharge. Bays vary in size and in type of shorefront.

4. *Embayment:* A confined coastal water body with narrow, restricted inlets and with a significant freshwater inflow can be classified as an embayment. These areas have more restricted inlets than bays, are usually smaller and shallower, have low tidal action, and are subject to sedimentation.

5. *Tidal River:* The lower reach of a coastal river is referred to as a tidal river. The coastal water segment extends from the sea or estuary into which the river discharges to a point as far upstream as there is significant salt content in the water, forming a salt front. A combination of tidal action and freshwater outflow makes tidal rivers well-flushed. The tidal river basin may be a simple channel or a complex of tributaries, small associated embayments marshfronts, tidal flats, and a variety of others.

6. *Lagoon:* Lagoons are confined coastal bodies of water with restricted inlets to the sea and without significant freshwater inflow. Water circulation is limited, resulting in a poorly flushed, relatively stagnant body of water. Sedimentation is rapid with a great potential for basin shoaling. Shores are often gently sloping and marshy.

7. *Perched Coastal Wetlands:* Unique to Pacific islands, this wetland type, found above sea level in volcanic crater remnants, forms as a result of poor drainage characteristics of the crater rather than from sedimentation. Floral assemblages exhibit distinct zonation while the faunal constituents may include freshwater, brackish, and/or marine species. Example: Aunu'u Island, American Samoa.

8. *Anchialine Systems:* These small coastal exposures of brackish water form in lava depressions or elevated fossil reefs, have only a subsurface connection to the ocean, but show tidal fluctuations. Differing from true estuaries in having no surface continuity with streams or ocean, this system is characterized by a distinct biotic community dominated by benthic algae such as Rhizoclonium, the mineral encrusting Schizothrix, and the vascular plant Ruppia maritima. Characteristic fauna, which exhibit a high degree of endemicity, include the mollusks Theodoxus neglectus and T. cariosus, the small red shrimp Metabetaeus lohena and Halocaridina rubra, and the fish Eleotris sandwicensis and Kuhlia sandvicensus. Although found throughout the world, the high islands of the Pacific are the only areas within the U.S. where this system can be found.

B. *Basin Structure:* Estuary Basins may result from the drowning of a river valley (coastal plains estuary), The drowning of a glacial valley (fjord), the occurrence of an offshore barrier (bar-bounded estuary), some tectonic process (tectonic estuary), or volcanic activity (volcanic estuary).

1. *Coastal plains estuary:* Where a drowned valley consists mainly of a single channel, the form of the basin is fairly regular, forming a simple coastal plains estuary. When a channel is flooded with numerous tributaries, an irregular estuary results. Many estuaries of the eastern United States are of this type.

2. *Fjord:* Estuaries that form in elongated, steep headlands that alternate with deep U-shaped valleys resulting from glacial scouring are called fjords. They generally possess rocky floors or very thin veneers of sediment, with deposition generally being restricted to the head where the main river enters. Compared to total fjord volume, river discharge is small. But many fjords have restricted tidal ranges at their mouths, due to sills, or upreaching sections of the bottom which limit free movement of water, often making river flow large with respect to the tidal prism. The deepest portions are in the upstream reaches, where maximum depths can range from 800 m to 1200 m, while sill depths usually range from 40 m to 150 m.

3. *Bar-bounded Estuary:* These result from the development of an offshore barrier, such as a beach strand, a line of barrier islands, reef formations, a line of moraine debris, or the subsiding remnants of a deltaic lobe. The basin is often partially exposed at low tide and is enclosed by a chain of offshore bars or barrier islands, broken at intervals by inlets. These bars may be either deposited offshore or may be coastal dunes that have become isolated by recent sea level rises.

4. *Tectonic Estuary:* These are coastal indentures that have formed through tectonic processes such as slippage along a fault line (San Francisco Bay), folding, or movement of the earth's bedrock, often with a large inflow of freshwater.

5. *Volcanic Estuary:* These coastal bodies of open water, a result of volcanic processes, are depressions or craters that have direct and/or subsurface connections with the ocean and may or may not have surface continuity with streams. These formations are unique to island areas of volcanic origin.

C. *Inlet Type:* Inlets in various forms are an integral part of the estuarine environment, as they regulate, to a certain extent, the velocity and magnitude of tidal exchange, the degree of mixing, and volume of discharge to the sea. There are four major types of inlets:

1. *Unrestricted:* An estuary with a wide unrestricted inlet typically has slow currents, no significant turbulence, and receive the full effect of ocean waves and local disturbances which serve to modify the shoreline. These estuaries are partially mixed, as the open mouth permits the incursion of marine waters to considerable distances upstream, depending on the tidal amplitude and stream gradient.

2. *Restricted:* Restrictions of estuaries can exist in many forms: bars, barrier islands, spits, sills, and more. Restricted inlets result in decreased circulation, more pronounced longitudinal and vertical salinity gradients, and more rapid sedimentation. However, if the estuary mouth is restricted by depositional features or land closures, the incoming tide may be held back until it suddenly breaks forth into the basin as a tidal wave, or bore. Such currents exert profound effects on the nature of the substrate, turbidity, and biota of the estuary.

3. *Permanent:* Permanent inlets are usually opposite the mouths of major rivers and permit river water to flow into the sea. Sedimentation and deposition are minimal.

4. *Temporary (Intermittent):* Temporary inlets are formed by storms and frequently shift position, depending on tidal flow, the depth of the sea and sound waters, the frequency of storms, and the amount of littoral transport.

D. *Bottom Composition:* The bottom composition of estuaries attests to the vigorous, rapid, and complex sedimentation processes characteristic of most coastal regions with low relief. Sediments are derived through the hydrologic processes of erosion, transport, and deposition carried on by the sea and the stream.

1. *Sand:* Near estuary mouths, where the predominating forces of the sea build spits or other depositional features, the shores and substrates of the estuary are sandy. The bottom sediments in this area are usually coarse, with a graduation toward finer particles in the head of the estuary. In the head region and other zones of reduced flow, fine silty sands are deposited. Sand deposition occurs only in wider or deeper regions where velocity is reduced.

2. *Mud:* At the base level of a stream near its mouth, the bottom is typically composed of loose muds, silt, and organic detritus as a result of erosion and transport from the upper stream reaches and organic decomposition. Just inside the estuary entrance, the bottom contains considerable quantities of sand and mud, which support a rich fauna. Mud flats, commonly built up in estuarine basins, are composed of loose, coarse, and fine mud and sand, often dividing the original channel.

3. *Rock:* Rocks usually occur in areas where the stream runs rapidly over a steep gradient with its coarse materials being derived from the higher elevations where the stream slope is greater. The larger fragments are usually found in shallow areas near the stream mouth.

4. *Oyster shell:* Throughout a major portion of the world, the oyster reef is one of the most significant features of estuaries, usually being found near the mouth of the estuary in a zone of moderate wave action, salt content, and turbidity. It is often a major factor in modifying estuarine current systems and sedimentation, and may occur as an elongated island or peninsula oriented across the main current, or may develop parallel to the direction of the current.

Group II—Hydrographic

A. *Circulation:* Circulation patterns are the result of the combined influences of freshwater flow, tidal action, wind and oceanic forces, and serve many functions: nutrient transport, plankton dispersal, ecosystem flushing, salinity control, water mixing, and more.

1. *Stratified:* This is typical of estuaries with a strong freshwater influx and is commonly found in bays formed from "drowned" river valleys, fjords, and other deep basins. There is a net movement of freshwater outward at the top layer and saltwater at the bottom layer, resulting in a net outward transport of surface organisms and net inward transport of bottom organisms.

2. *Non-stratified:* Estuaries of this type are found where water movement is sluggish and flushing rate is low, although there may be sufficient circulation to provide the basis for a high carrying capacity. This is common to shallow embayments and bays lacking a good supply of freshwater from land drainage.

3. *Lagoonal:* An estuary of this type is characterized by low rates of water movement resulting from a lack of significant freshwater influx and a lack of strong tidal exchange because of the typically narrow inlet connecting the lagoon to the sea. Circulation, whose major driving force is wind, is the major limiting factor in biological productivity within lagoons.

B. *Tides:* This is the most important ecological factor in an estuary, as it affects water exchange and its vertical range determines the extent of tidal flats which may be exposed and submerged with each tidal cycle. Tidal action against the volume of river water discharged into an estuary results in a complex system whose properties vary according to estuary structure as well as the magnitude of river flow and tidal range. Tides are usually described in terms of their cycle and their relative heights. In the United States, tide height is reckoned on the basis of average low tide, which is referred to as datum. The tides, although complex, falls into three main categories:

1. *Diurnal:* This refers to a daily change in water level that can be observed along the shoreline. There is one high tide and one low tide per day.

2. *Semidiurnal:* This refers to a twice daily rise and fall in water that can be observed along the shoreline.

3. *Wind/Storm Tides:* This refers to fluctuations in water elevation to wind and storm events, where influence of lunar tides is less.

C. *Freshwater:* According to nearly all the definitions advanced, it is inherent that all estuaries need freshwater, which is drained from the land and measurably dilutes seawater to create a brackish condition. Freshwater enters an estuary as runoff from the land either from a surface and/or subsurface source.

1. *Surface water:* This is water flowing over the ground in the form of streams. Local variation in runoff is dependent upon the nature of the soil (porosity and solubility), degree of surface slope, vegetational type and development, local climatic conditions, and volume and intensity of precipitation.

2. *Subsurface water:* This refers to the precipitation that has been absorbed by the soil and stored below the surface. The distribution of subsurface water depends on local climate, topography, and the porosity and permeability of the underlying soils and rocks. There are two main subtypes of surface water:

a. *Vadose water:* This is water in the soil above the water table. Its volume with respect to the soil, is subject to considerable fluctuation.

b. *Groundwater:* This is water contained in the rocks below the water table, is usually of more uniform volume than vadose water, and generally follows the topographic relief of the land, being high below hills and sloping into valleys.

Group III—Chemical

A. *Salinity:* This reflects a complex mixture of salts, the most abundant being sodium chloride, and is a very critical factor in the distribution and maintenance of many estuarine organisms. Based on salinity, there are two basic estuarine types and eight different salinity zones (expressed in parts per thousand—ppt).

1. *Positive estuary:* This is an estuary in which the freshwater influx is sufficient to maintain mixing, resulting in a pattern of increasing salinity toward the estuary mouth. It is characterized by low oxygen concentration in the deeper waters and considerable organic content in bottom sediments.

2. *Negative estuary:* This is found in particularly arid regions, where estuary evaporation may exceed freshwater inflow, resulting in increased salinity in the upper part of the basin, especially if the estuary mouth is restricted so that tidal flow is inhibited. These are typically very salty (hyperhaline), moderately oxygenated at depth, and possess bottom sediments that are poor in organic content.

3. *Salinity zones (expressed in ppt):*

a. Hyperhaline—greater than 40 ppt.

b. Euhaline—40 ppt to 30 ppt.

c. Mixohaline: 30 ppt to 0.5 ppt.

(1) Mixoeuhaline—greater than 30 ppt but less than the adjacent euhaline sea.

(2) Polyhaline—30 ppt to 18 ppt.

(3) Mesohaline—18 ppt to 5 ppt.

(4) Oligohaline—5 ppt to 0.5 ppt.

d. Limnetic: Less than 0.5 ppt.

B. pH Regime: This is indicative of the mineral richness of estuarine waters and fall into three main categories:

1. Acid: Waters with a pH of less than 5.5.

2. Circumneutral: A condition where the pH ranges from 5.5 to 7.4.

3. Alkaline: Waters with a pH greater than 7.4.

[FR Doc. 90-16511 Filed 7-20-90; 8:45 am]
BILLING CODE 3510-08-M

APPENDIX E

DELAWARE NATIONAL ESTUARINE RESEARCH RESERVE

FISH AND WILDLIFE MANAGEMENT PLAN

The following appendix is presented as a proposed conservation and management philosophy for the protection, enhancement, restoration and utilization of fish and wildlife resources and their habitats on DNERR lands or in association with the DNERR program. The report views the conservation and stewardship of these living resources in a historical perspective of what we used to have and what we have done to it, providing the foundation for a management strategy to guide what we now need to do. As such, this contribution is not intended to be a step-by-step manual of conservation and management practices, but rather to present a framework upon which detailed action plans can be built.

The report was prepared under contract to the DNERR by Anthony Florio, wildlife consultant. Mr. Florio is well known throughout Delaware and the Middle Atlantic region as a professional wildlife manager, naturalist, outdoor artist and photographer. After receiving a degree in wildlife management from the University of Connecticut, Tony spent a 37-year career as a wildlife biologist for the State of Delaware, where he was the Wildlife Section Manager in the Division of Fish and Wildlife from 1974 until his retirement from state services in 1985.

DNERR

FISH AND WILDLIFE MANAGEMENT PLAN

DNERR

FISH AND WILDLIFE MANAGEMENT PLAN

DNERR MANAGEMENT PLAN FOR FISH AND WILDLIFE

THE PAST

DISCOVERY AND COLONIZATION

It was Henry Hudson, during his celebrated third voyage in the good ship Crescent, better known as the Half-Moon, who first ascended what later became known as the Delaware Bay. As most school children used to know, the voyage took place in 1609, and after ascending the shoaly estuary for a bit, Hudson turned and rounded the east cape, and proceeded towards what eventually became known as the Hudson River.

As a result of that expedition, he named these two estuaries the North and South Rivers, and the appellations prevailed for a time, at least. It was only later when the English, as was the wont of the more ambitious land-grabbers of the time, who changed the name of the latter to "Delaware." They did this to give credence to the fallacy that it was discovered by Lord de la Warr on his voyage to Virginia in 1610. Actually, the good Lord never set eyes upon the river. Such is the history of the ways of white men in identifying geographical areas which they have, to use their own euphemistic term, "discovered".

In 1623 Cornelius May ascended the South River, settled a colony and built Fort Nassau, just below present day Philadelphia. The object of this first establishment on the Delaware was trade with the aborigines, which apparently turned

no profit, for the good burghers quit the settlement soon after. It was DeVries who first attempted to create a thriving community here, when he entered the South River in the spring of 1631 and established a colony near Cape Henlopen. Leaving his commissary Gillis Hassett in charge, he sailed for Holland, planning to return subsequently to reprovision the community. Hassett ostensibly quarreled with the Indians, for on his return DeVries found the settlement utterly destroyed, and the 32 inhabitants massacred.

Thus, from its discovery in 1609 until 1637, no successful colony had been established on the Delaware. However, in 1638 Peter Minuit, who had been dismissed from his office with the Holland West India Company, arrived with an expedition from Sweden, having gone to that country and been appointed by the Swedes to lead a voyage to the South River. Minuit established Fort Christiana near the present city of Wilmington, which proved to be the first permanent settlement on the Delaware.

The early Swedish settlements were followed in turn by Dutch and English communities. The Dutch wrested control from the Swedes, who could not match them in military prowess; but the sovereignty of the area eventually devolved to the English, with the signing of the Treaty of Westminster in 1674. Thus, after much wrangling, the English finally assumed control of the Delaware, and all Duke of York patents, initially granted in 1664, were renewed.

In 1681, to clear a debt of L15,000 owed to William Penn, King Charles signed a patent deeding "Pennsylvania" to him. And in 1682, James, Duke of York, issued a protective deed to Penn for Pennsylvania, New Castle and Horekill (which included the two lower counties, Kent and Sussex).

Penn then sailed for America, arriving in New Castle, Delaware, on October 28, 1682. However, his boundary troubles were not over, for Lord Baltimore claimed jurisdiction over much of the three lower counties, leading to a territorial struggle which raged for over a century and which was not settled until 1768, with an agreement duly signed by the heirs of Penn and Lord Baltimore. This was the famous Mason & Dixon line, markers of which may be viewed to this day at certain points along the Maryland-Delaware boundary. The final act in this long drawn out dispute took place in 1691, when the "territories", or three lower counties, met and compelled Penn to accede to their demands that his government be divided, officially creating the independent state of Delaware.

FISH AND WILDLIFE

The early settlers of Delaware were justifiably impressed with the varied and abundant supply of fish and game the area had to offer.

A detailed account by Captain Thomas Young, who explored the river in 1634, provides a first-hand description which has survived to this day:

"The river aboundeth with beavers, otters, and other meaner furrs....I think few rivers of America have more... The soyle is sandy and produceth divers sorts of fruits, especially grapes, which grow wild in great quantities. The earth being fruitful is covered over with woods and stately timber, except only in those places where the Indians had planted their corne. The countrey is very well replenished with deere and in some places store of Elkes. The low grounds of which there is great quantitie excellent for meadowes [for pasturage] and full of Beaver and Otter. The quantity of fowle is so great as hardly can be believed, wee tooke at one time 48 partriches together, as they crossed the river chased by wild hawkes- there are infinite number of wild pidgeons, blackbirds, Turkeys, Swans, wild geese, ducks, Teales, Widgins, brants, herons, cranes, etc., of which there is so great abundance, as that the rivers and creekes are covered with them in winter. Of fish heere is plentie, but especially sturgeon."

Even DeVries, in 1631, had described his entry into "...a fine navigable stream, filled with islands, abounding in oysters,..... and flowing through a fertile region." His appellation, Zwaandael, "Valley of Swans", is also illustrative of the waterfowl he found there.

Peter Lindstrom, in his "Geographica America", ca 1655, describes the Christina as deep, and rich in fish, the land surrounding "...flowing with milk and honey". The animals he describes include [mountain] lions, black bear, wildcats, lynxes, and wolves.

During the mid-1600's, after going through the trouble of collecting a poll tax to pay for a bounty of 40 gilders on each wolf head, the court in New Castle decided that this was an ineffective way of controlling these beasts, and advised the landowners to dig wolf pits instead.

Probably the most lyric image of the area was that portrayed by John Fenwick, in his invitation to settlement in West Jersey (ca 1680):

> "... how prodigal...hath Nature been to furnish this Country with all sorts of Wild Beasts and Fowl, which every one.... may Hunt at his own pleasure, where... he may furnish his House with excellent fat Venison, Turkies, Geese, Heath-hens, Cranes, Swans, Ducks, Pigeons, and the like; and... he may [also] go a fishing, where the Rivers are so furnished that he may supply himself with Fish before he can leave off the Recreation."

It was the fur trade that probably first brought the white man to Delaware. And trade they did. On the fifth Swedish expedition, the ship "Fama" arrived with goods to barter with the Indians. When she sailed on June 20, 1644, she was laden with 20,467 pounds of tobacco, and 2,136 beaver skins. It is significant that the central figure on the seal of New Netherlands is a beaver.

But all was not "milk and honey," for Peter Kalm, a trained observer, describes in his "Travels in North America" in the mid 18th century the mosquitoes, gnats and other pestiferous insects which made life unbearable for newcomers to the region.

THE LAND

The land, except for the vast tidemarshes which bordered the Delaware, and the corn fields cultivated by the Indians, was covered in pristine forest, with deciduous species predominating in the north, and generally giving way to conifers as one

proceeded south. Wild grapes were in abundance. The soil, a sandy loam in Sussex, became heavier in New Castle, and was fertile. Corn, tobacco, small grains, peaches, cattle, wool and a variety of other crops were produced. Timber, both hard and softwood, was in abundance; indeed, because of the long drawn out boundary struggle between Lord Baltimore and William Penn, southwest Sussex remained unsettled for an extended period of time. Thus, when a settlement was finally reached, large stands of old growth oak and pine were available in the Nanticoke River area for the construction of the Delaware Ram, a ship especially designed for navigation and trade in and out of the Chesapeake Bay area.

THE INDIANS

> "A few more passing suns will see us here no more, and our dust will mingle with these same prairies. I see as in a vision the dying spark of our council fires, the ashes cold and white. I see no longer the curling smoke rising from our lodge poles. I hear no longer the songs of the women as they prepare the meal. The antelope have gone; the buffalo wallows are empty. Only the wail of the coyote is heard. The white man's medicine is stronger than ours; his iron horse rushes over the buffalo trail. He talks to us through his whispering wire. We are like birds with broken wings. My heart is cold within me. My eyes are growing dim-I am old."
>
> Chief Plenty Coups (Crow)

The American Indian was a hunter and gatherer. True, he did grow crops like corn and tobacco, but he gleaned his primary sustenance from the bounty, amply described previously, of the land and waters of his home. Moreover, except for minor practices like the clearing of small fields for his crops, he

lived within the parameters described by his environment. And since he took from this environment less than it normally produced; except for rare natural catastrophes which affected the animal and plant populations he depended upon for his food supply, his life was one of contentment and security.

As a hunter he reigned supreme. But then again, this was true of most aboriginal peoples, even until this day, whether they were Apache or Lapp, Kung Bushman or Maori, Nanticoke or Inuit.

But with the coming of the white man he and his way of life were doomed. The history of the treatment of indigenes by Europeans is a litany of coercion, aggression and vicious subjugation. Ferris, in his "History", says:

> "No one conversant with the history of that period [early America] can be ignorant of the wanton acts of cruelty, frequently committed on the defenceless natives, by the roving adventurers of that day..."

There were exceptions to the above. Scharf tells us that of all the early settlers in Delaware, it was the Swedes, "... simple, loyal, steadfast, who lived at peace with one another and the Indian... The atrocities committed by the English and Dutch were unknown to these kind people."

While even the Swedes, however, may have had some difficulties, the example set by William Penn, a legislator "... a century ahead of his time", was more commendable. He came to America not as an aggressor, but as a statesman and peace maker. His credo:

"Obedience without liberty is slavery. Liberty without obedience is confusion."

he staunchly defended. The years of his dominion in the New World were strife free - no blood was spilled in the name of civilization because of the actions of the Society of Friends.

THE DEVELOPING YEARS

IMMIGRATION AND POPULATION

Following the initial settlement of Delaware by the Swedes, Dutch and English, immigration into the first state increased with the passage of time, cresting with the great waves of migration which occurred in the 19th century. The pre-Columbian population of the three lower counties was estimated at a few thousand Nanticokes and Lenapes. Theses tribes were displaced by Europeans who in turn brought over African slaves, and to these other ethnic groups have been added, most recently, southeast Asians.

The population curve of any locality is a function of many variables: climate, the economy, migration patterns, opportunity, natural resources, and others. This pattern is difficult to predict, and more difficult to control. An excess of people in a given area will stress the ability of that region to support its citizenry within reasonable levels of comfort. We like to refer to the maintenance of an acceptable "quality of life."

The story of mankind is infused with civilizations which have mysteriously "disappeared". The truth of the matter is that these populations have, more often than not, exceeded the ability of their homeland to support them. The people either did not recognize, or saw and refused to recognize, the coming crises.

There is nothing in the above which precludes such an event from happening in today's world, even with all of its technological sophistication. The white man's medicine, while strong enough to dispossess the Indian, may not sustain his own excesses.

AGRICULTURE AND INDUSTRY

The primary construction material of the area was at hand and in abundance - the forest primeval stretched to the setting sun, as far as the eye could see. Timber and dimension stock for homes, factories, tanneries, mills, shipbuilding, and a hundred other uses existed in seemingly limitless amounts.

The land was thus cleared for agriculture, and by the mid-nineteenth century the last of the old growth timber was gone, and the forest complement of the state was supplanted in large degree by cropland and orchard.

Dams were thrown across most streams to provide power for the ubiquitous grist mill; the number of mill ponds this created at one time exceeded 200, and in many a wooded branch, to this day, vestiges of former mills may be seen. Thus man replaced the beaver, which had by this time been extirpated from the state, as the primary builder of dams.

The duPont powder mills on the Brandywine evolved eventually into the large petro-chemical complex that brackets the Delaware River in the Wilmington-Philadelphia-Camden area. And the older, coal-fired electric generating plants in the region have been supplemented by the nuclear facility at Salem, to better meet the

growing energy needs of the Delaware Valley.

THE ENVIRONMENT

Early on, the effect that the white man exerted upon the environment was one more of change than of detriment. While the Indian had lived within his environment, the European modified the land to suit his needs.

However, with the passage of time these changes became more commonplace, of greater amplitude, and more destructive. For a while those initial modifications may have little affected the quality of the soil, water and air; but by the 20th century pollution, erosion and gross misuse had all but destroyed the once pristine habitat that existed in the new world prior to settlement.

Interestingly enough, a cursory oversight of the region would have revealed little to the untrained eye. Fields were golden with bountiful crops; sky, except for the Wilmington area, a cumulus-dappled blue; bay a glorious seascape of sky and water; marshland filled with the song of pipe-reed and blackbird. True, the oyster and shad catches were steadily declining; the deer had long been gone; eagle and osprey populations were declining; but these and other changes had come about so slowly that only the demographer and a few others paid any attention to them.

But enough attention was focused on the problem to bring about the first protective legislation. These early attempts at stemming the tide of environmental degradation were of necessity crude, based mostly upon regulations which prohibited those

practices which grossly undermined the environment. The genesis of environmental protection, however, had finally come about.

THE ESTUARY

DEFINITION AND MANAGEMENT

The Delaware Valley encompasses all lands and waters that drain into the Delaware estuary, which in its turn includes all wetlands and streams flowing into the river and bay. This estuary, one of the richest in the world, cannot be defined within finite limits. Its entire periphery, from the wetlands that feed it the nutrients so essential to its life, to its southern terminus in the Atlantic Ocean, waxes and wanes with the seasons, the climate, and the tides. Moreover, the direction and amplitude of these changes may not be predictable - the capriciousness of nature is a fundamental biological principle. The estuary, therefore, is a living, ever changing biological entity.

These factors, it appears, may be lost to those who would "protect" the estuary with a plethora of prohibitive regulations. The regulatory process is not a management principle in of itself, nor should it be ever utilized as such. It is a tool of management, which in turn is a philosophy which must be derived from a biological-historic-conservation perspective.

A rigid regulatory process which is designed to maintain the status quo is contrary, by definition, to the fundamentals of estuarine ecology. The estuary, therefore, must be managed, and

the goal of this management must be to direct or influence these changes in an attempt to enhance, improve or restore the estuary.

THE TIDEMARSH

The tidemarsh is the circulatory system of the estuary. Thru its meandering streams and guts flow the nutrients, the life's blood, the very essence of this richest of natural resources. Its fauna, from the zooplankton of its muddy waters to the fish it nutures; from the pestiferous insects it is damned for, through vole and muskrat, otter and raccoon, deer and fox, eagle and osprey; is without peer in the temperate zone.

Woodland Beach old timers reminisce of the days when the ducks were "... so thick you couldn't shoot a hole thru 'em..." and "... a man had to make two, three trips to haul off a day's rat catch". Fenwick tells us that, "from the marshes near Leipsic in early days large numbers of muskrats were caught, and as many as a hundred thousand skins in one year have been shipped from there."

Captain Young, in his description quoted previously, refers to "... beavers, otters and meaner furrs...". As beaver and otter stocks were reduced the major trapping effort devolved to the muskrat, where it remains to this day.

The Dutch, with their history of reclaiming wetlands from the sea, emulated this procedure in Delaware, diking and draining the marshlands of New Castle County in an attempt to convert them to productive farmland. Their efforts, however, were thwarted by the muskrat, which holed the dikes and rendered them useless.

As the fur trade expanded it encompassed these same "meaner furrs", and the landowners were not long in exploiting this market by diking the wetlands to contain, rather than drain. This procedure improved the marsh, for embanked meadows produced a superior rat, and thus was launched in the new world the first productive marsh management practice. There are meadows in New Castle County today which have been impounded for more than 200 years.

It is important to note here that the muskrat has been an economic mainstay of the Delaware tidemarsh farm, producing millions of dollars in income over the years and paying off many a farm mortgage. Moreover, it has been trapped on a sustained yield basis, and this income has encouraged many marsh landowners to protect and improve this vital resource.

Over the years, however, wetlands throughout the continent have been drained, filled, polluted and otherwise degraded. The percentage of marshland so destroyed has been staggering; while it has slowed, the practice continues. In addition, Delaware wetlands have been "naturally degraded" by a severe infestation of the noxious plant Phragmites. This aggressive interloper is crowding out the indigenous Spartinas, resulting in significantly reduced muskrat and waterfowl use of these once prime marshlands.

Only as the effects of estuarine degradation have become obvious to even the untrained eye; as the value of wetlands to

the environment has, finally, been indicated; has change been inaugurated. This has propelled us into the first, "regulatory", phase of protecting the estuary.

Our final goal should be that of evolving a philosophy of total estuarine management, based upon research and education, and treating all phases of regulation, utilization, improvement, restoration, and revitalization of that most vital of natural resources that the Delaware estuary is.

CHRONOLOGY

Before we can think of devising an estuarine management plan, we should sit back and assimilate, from a chronological overview, at least those major natural and man-made events which have, in the last 350 years, significantly impacted Delaware's estuarine marshlands.

1712	Diking and draining tidal marshes
1740	Thoroughfare - Smyrna River
1878	Tidal wave - great storm
1930's	Mosquito control grid ditching
1930's	Permanent Indian River inlet
1939-61	Bombay Hook impoundments
1959-61	Little Creek mosquito control impoundments
1950 ->	Phragmites intrusion
1980's	Open marsh water management
1980's	Snow goose eat outs Bombay Hook NWR
THROUGHOUT	Sinking mid-Atlantic coastline

That change, whether it be historical, annual, daily; natural or man-made; is an integral function of the estuary, should be obvious from the above. This is why any such plan should be designed as one that attempts to control the rate, direction and amplitude of change, in order to best maintain the ecological integrity of the estuary.

DNERR WILDLIFE MANAGEMENT PLAN

INTRODUCTION

The NERR project attempts to approach the problem of long-term, integrated estuarine management by establishing reserve areas within selected estuaries; and in the Delaware scenario, to further establish a research and educational facility within her reserve. From this proposed St. Jones facility field studies and educational activities may be carried out which will in time lead to a total recovery of the Delaware estuary. Such an accomplishment will greatly benefit the country environmentally, economically, aesthetically and educationally.

This wildlife management plan should be derived from an historic and philosophic perspective. It should attempt to correct the sins of the past, to improve upon existing management techniques, and to explore new areas of fish and game management over an extended period of time.

HUNTING, FISHING AND TRAPPING

Hunting, fishing and trapping have been major pursuits of man throughout history. We have seen where aboriginal man had in general lived within the constraints of his environment. But then he was a hunter and gatherer, and his population level, like those of the animals about him, were environmentally controlled.

The white man, however, brought civilization with him, the tools of which enabled him to shape and change the environment to suit his needs. During most of history, his predilection for coercion, subjugation and plunder was extended beyond the peoples he conquered, to include nature's bounty.

Thus the beaver, which was a major attractant to the new world, was soon extirpated from most of its range. So too were the mountain lion, the white-tailed deer, the buffalo and a host of others; some, like the passenger pigeon and Labrador duck, never to return.

In Delaware over 100 years were to pass after its initial settlement before the first laws were enacted to protect wildlife from overhunting. In 1740 a closed season, and in 1841 complete protection was extended to the white-tailed deer. Not until 1954 was this species again allowed to be hunted. Since that time, seasons and bag limits have been increased, while the population continues to climb.

The wild turkey, a species which Ben Franklin wished to be our national bird, was largely exterminated from its original range. Today, the turkey has been re-established in all lower

forty eight states, and is again being harvested under controlled conditions.

Turkey and deer are excellent examples of how many wildlife species, all but eliminated by the wanton exploitation of early settlers have, under sound biological management, been restored to their former ranges.

This historic cycle of exploitation, protection, management, and utilization may be applied to any renewable resource. As man finally becomes aware of the constraints he must employ he becomes more adept at bringing about the first principle of conservation: "the wise use of natural resources, to benefit the most people."

Probably the practice most subject to criticism in today's world is that of trapping. Most of the faultfinding directed at the fur industry comes from people who are urban-oriented, who respond emotionally to a biologically and economically sound procedure.

The muskrat today provides significant income to the Delaware tidemarsh farmer, who manages his wetlands to provide a sustained yield of fur. It is intriguing to note that the critical rhetoric that is directed against hunting and trapping is, curiously enough, absent in many cases where domestic animals are raised for slaughter and the production of foodstuffs.

The practice of utilizing various animal species for food and fur has devolved to a philosophy of conservation of renewable resources. Interestingly enough, it has not been the

protectionists who over the years have been responsible for the preservation and management of the nation's wildlife resources, but the sportsmen who (1) became aware of, (2) enacted legislation, and (3) provided the funding necessary to insure the survival of wildlife in America today.

NON-CONSUMPTIVE USES

In the parlance of the times, biologists like to use the words "consumptive" (hunting, fishing, trapping) and "non-consumptive" (birding, hiking, camping, etc.) to describe how people enjoy the out-of-doors. A poor choice of words, since to "consume" means to "... eat or utilize completely... to do away with completely and destructively."

The modern wildlife manager manipulates habitat and regulations to utilize a renewable resource. In this sense he does not "consume", but "conserves" or "husbands" (to protect from loss or destruction).

At any rate, non-consumptive users are those whose interest in our wildlife and outdoor resources is aesthetic, and in and of itself does little to affect the resource. On the one hand, the consumptive or conserver uses these resources within limits determined by sound conservation principles. On the other, the non-consumptive enjoys them for their intrinsic value.

During the last half of the twentieth century a plethora of organizations, self-proclaimed "environmentalists", have arisen -

especially in the United States and western Europe - where they collectively title themselves "greens". The doctrines espoused by these groups, particularly the more militant, are narrow in perspective and strident in tonality. These people give but lip service to basic biological principles - theirs is a crusade based upon emotionalism.

This brings us to a major problem facing the wildlife manager today, who as we have seen above, has recognized the sins of the past and taken corrective action by developing the sound conservation practices which have gone so far in restoring and managing our wildlife resources.

He was not prepared for, however, and therefore has been slow to react, to these social aspects of wildlife management. Times change, and while animal population dynamics respond to age old stimuli, vocal special interest groups pose today's challenge, which must be addressed.

PROJECTS

The following topics are outlines of suggested research, educational and management projects which may be incorporated into the management plan. They represent the wide array of problems which exist, and should be addressed in order for DNERR to accomplish its goals. These projects have been subdivided into the categories listed below:

A. MONITORING

The Sinking Coastline
Phragmites Intrusion
Snow Goose Depredations
Little Creek Impoundments

B. RESTORATION AND MANAGEMENT

Cedar Swamp
North Mahon Marsh
Tidemarsh Sheet Water
The Bigstone-Mispillion Marsh

C. APPLIED RESEARCH

Development of Continuing Regulations
Open Marsh Water Management
Phragmites Control
Continuing Development of Water Management Techniques
Snow Goose Management

D. INFORMATION AND EDUCATION

E. CONCLUSION

MONITORING

The Sinking Coastline

Because of the combination of coastal subsidence and a rising sea level, the mid-Atlantic coastline is "sinking" at, geologically, an extremely rapid rate. This is especially true at certain sites along the Delaware littoral, Port Mahon being a case in point. The combination of coastal subsidence, high tides and wind action have accelerated the rate of shoreline erosion here, with devastating results:

1. Hundreds of acres of bay front tidal marshlands have been lost.
2. A sea wall installed by the State of Delaware in the 1980's to protect a portion of this shoreline failed before it was completed.
3. The Port Mahon road has lost its surface and been overrun on many occasions. After each event it has been temporarily patched with gravel.
4. Rip-rap installed to protect other parts of the shoreline has proven grossly inadequate.

It is obvious from the above that coastal subsidence in Delaware must be monitored from a time-space perspective, in order that corrective action be initiated in any given area before damages incurred rise to a level where they become insurmountable or economically unfeasible to correct.

Phragmites Intrusion

Phragmites is an aggressive, pestiferous plant which has invaded Delaware's wetlands and is supplanting the cordgrasses, three-squares, cattails and other indigenous species at an alarming rate. Its presence has degraded the marshes ecologically, resulting in sharp declines of native wildlife in general, and especially economically important species such as waterfowl and muskrats.

In an attempt to solve the problem, the Delaware Division of Fish and Wildlife, in concert with the U.S. Fish and Wildlife Service and the Monsanto Chemical Corporation, have through assiduous research developed a "soft" herbicide which has provided the most successful control of Phragmites to date. In keeping with its desire to aid the Department of Natural Resources in its efforts to suppress this noxious plant, the legislature has provided funding for a cost-sharing program which is made available to landowners who wish to restore their wetlands.

The purpose of this project should be to monitor the extent of the Phragmites incursion and the ability of the plant to survive under continuing control efforts.

Snow Goose Depredations

Greater snow goose wintering populations began a rapid build-up in Delaware during the 1980's. The feeding activities of this species presents a striking picture -- the birds wheeling and turning in close knit groups numbering in the thousands, all

the while honking and cackling in raucous cacophony.

This bird has historically fed on the rootstocks of tidemarsh plants, especially the cordgrasses. In recent years they have begun to emulate their Canadian brethren, feeding in harvested corn and small grain fields.

Where they have fed on the tidemarsh, however, their sheer weight in numbers has resulted in large areas where all emergent plants, including their rootstocks, have been stripped. Here have been left broad tracts of completely denuded wetland, so-called "eat-outs", which then become subject to tidal erosion and destruction.

This has in fact happened in Delaware, especially on Bombay Hook Island, but in other places as well. While control efforts have slowed the birds penchant for overfeeding localized tidemarsh areas they have failed to curtail this activity.

Snow goose eat-outs should be monitored. Their location and extent should be recorded, especially in light of control efforts and the recent inclination of this species to divert at least a part of its feeding effort to harvested upland fields.

Little Creek Impoundments

In 1959, in an effort to establish long term, biological control of mosquitoes breeding in the Little Creek marshes, the State of Delaware installed a series of large, low-level impoundments just south and north of Little River. In addition to effectively controlling mosquito production in an area which had historically posed a severe pest problem to the Dover area,

these pools proved to be a boon for large numbers of wintering waterfowl, and an important breeding and resting area for ducks, shore and wading birds.

The impoundments are largely owned by the Division of Fish and Wildlife, which manages them as waterfowl resting and harvest areas, and are extremely popular with the bird watching community. In addition, they have served as test areas for the development of newer and more refined water management dike and maintenance techniques.

It is most important that these areas be properly maintained; that they be continually monitored from mosquito control, wildlife management, estuarine ecology, and non-consumptive use perspectives; and especially as these perspectives compare to other continuing, modified, or newly developed estuarine management techniques.

RESTORATION AND MANAGEMENT

Cedar Swamp

The Cedar Swamp area is a rectangular block of land bordered on the north by the Taylors Bridge light road, on the west by Route 9, on the south by the Smyrna River, and on the east by the Delaware Bay. It encompasses about 6000 acres of tidemarsh, farm and woodland.

In the mid nineteenth century the swamp supported a fine stand of white cedar, which was surrounded by prosperous farms. At that time the road ran south and east from Taylors Bridge and

before reaching the bay turned south, then ran along the shoreline to Collins Beach where it joined the east-west road from Flemings Landing, completely encircling the swamp.

It was largely a fresh water marsh and drained from its southeast quadrant through a pair of ditches which ran beneath the road just north of the Hygenia House, a hotel owned by Frank Collins of the beach of the same name.

In 1878 a severe storm struck the Delaware Bay and at its height spawned a great tidal wave, which did substantial damage to property, livestock and bay shore. It created a break through the dunes south of Hygenia House, isolating it from Collins Beach. With the passage of time the tidal surge through this gap caused it to widen and deepen. This in its turn enlarged and changed the swamp dramatically.

In time this once pristine fresh water cedar swamp became a salt water inlet. The cedar trees succumbed, and the fresh water cattails and bulrushes were replaced by cordgrasses. The most recent ill to befall the swamp is the intrusion of Phragmites, which is replacing the Spartinas.

In the 1960's most of the swamp area was methodically incorporated into a single holding by the Shell Oil Company, which had planned to build a refinery on the site. Fortunately, this event never came to pass, and the ensuing controversy was in good part responsible for the passage of Delaware's landmark Coastal Zone Act. Most recently the area was subdivided into ten large tracts, with the swamp proper and the shoreline parcels

devolving to the State of Delaware.

And so the Cedar Swamp, once fresh and highly attractive to waterfowl and muskrats, has today degenerated ecologically into a marsh where plumes of feathergrass sway in a wind that bore the sound of myriad waterfowl voices, its epitaph written on the bleached stumps of long dead cedars.

The Cedar Swamp can and should be restored. The State of Delaware has the technology and the resources to accomplish this task. DNERR should undertake a feasibility study to ascertain the engineering needs, ecological benefits of, and costs of closing the break, installing a controlled outlet to the Smyrna River, and designing a water management regimen - all with the goal of rehabilitating this once pristine wetland.

North Mahon Marsh

As stated under "Monitoring" the sinking coastline has seriously impacted the Delaware littoral, especially in the Port Mahon area. If the North Mahon marsh is to be saved something must be done, and very soon.

The Mahon sea wall has long since failed, and the rip-rap located just to the south of it is inadequate at best. The road has been all but washed away and will be breached in the immediate future. It will be the Cedar Swamp all over again. The tide will surge through the break, creating a dendritic pattern of tidal guts within the marsh complex, which will erode it severely. It will drain more completely on low water, and Phragmites will move into a then more attractive site for

this plant to establish itself. The marsh will become ecologically much less attractive for ducks, geese, shore and wading birds.

With the road gone the Mahon launching area, the recreational fishing pier, commercial fishing boat dockages, and the Air Force jet fuel off-loading facility will be isolated. The former will all have to be abandoned; the latter serviced by boat, if indeed the pipeline itself survives. In addition, many more hundreds of acres of tidemarsh will be lost to erosion, exacerbating a process which has only accelerated in the past 30 years.

Based upon the above, DNERR should undertake a project designed to:

1. arrest the process of shoreline erosion
2. protect the access road to Port Mahon
3. install water control structures which will enable an ecologically sound water management regimen to be effected.

Tidemarsh Sheet Water

The first serious attempts to dewater the Delaware tidemarshes were undertaken by early Dutch settlers in New Castle County in order to create additional farmland. Major upland drainage activities over the years have been concerned with removing excess water from cropland. These efforts increased with the passage of time, culminating with the wholesale agricultural drainage projects of the 1960's and '70's.

By far the most widespread estuarine drainage activities occurred during the 1930's, when hundreds of miles of tidemarsh ditching was completed in an attempt to attain statewide mosquito control. These grid systems traversed most Delaware marshes; they may be seen to this day, especially from the air.

Grid ditches exerted both short and long term effects on the tidemarsh. In the short term they expedited the flow of "trickle tides" (rainwater), storm and wind tides from these wetlands. This removed the standing or sheet water from the marsh surface and with it the environment so necessary for mosquito eggs to hatch.

In the long term they lowered the mean water level and increased the salinity of the tidemarsh zone. This resulted in a slow yet irreversible change in vegetation from the more beneficial, fresher water loving plants like cattails, smartweeds, three-squares and millets; to the "hightide bushes", cordgrasses and other more saline loving plants.

An insidious consequence of the above, which by its very nature allowed the damage to continue for the life of the drainage program, was the significant drop in the use of these wetlands by waterfowl, muskrats and wading birds. In addition, since most natural marshland sloughs and ponds were tied into the system - and there were thousands involved - these were effectively removed as a Delaware tidemarsh feature.

The economic results were calamitous. Muskrat catches first increased as rats moved closer to the ditches for water, making

them easier to harvest; then fell precipitously as their habitat deteriorated. The advent of the noxious plant Phragmites only served to exacerbate this situation.

DNERR should appraise the historic loss of sheet water as a result of the wholesale drainage of tidemarsh sloughs and ponds. In addition, it should identify those marshes where little or no attempts have been made to reclaim such wetlands, and to design methods by which sloughs, ponds and sheet water may be restored to a degree which will rehabilitate them.

The Bigstone-Mispillion Marsh

Just after the turn of the century Frank Greco, who owned nearly 4000 acres of marsh and farmland in southeast Kent County, built a canal in order to expedite the flow of produce from his land to the Philadelphia market. This waterway ran from the Bigstone Beach road in a southeasterly direction for two and one half miles. At this point it approached the dune line to within a few hundred feet. It then turned slightly landward and ran south for about a mile, where it entered the Mispillion River - quite an extraordinary undertaking for the time.

However, this ambitious project was terminated when Greco was not allowed to cross the road with his project. He moved to Milford and continued to ship via railway to market. Tragedy overtook the family soon afterward when the parents were carried off after eating poisonous mushrooms, leaving a sole surviving daughter. The enterprise waned and died along with its promoter, to be known to future generations on maps of the area simply as

"Grecos Canal".

In the course of time the sinking Delaware coastline, migrating inexorably and ever westward, literally caught up with the waterway, where its apex most closely approached the bay. A few years ago the canal was breached at this point, and the age old sagas of the Cedar Swamp and Woodland Beach were repeated. As the tidal surge races back and forth through this opening the whole natural drainage pattern of this vast marsh complex will be reordered. The primary victims of this event, once again, will be the waterfowl and muskrats which utilize these wetlands.

DNERR should undertake a study of the Bigstone Mispillion marsh with the objective of salvaging this area before major damage to its wildlife habitat occurs. Again, the technology is available; and the funding, at this point, a mere fraction of what will be required within a few years.

APPLIED RESEARCH

Development of Continuing Regulations

The regulatory process is a tool of management, and estuarine management should be viewed as a fluid, continually changing process, designed to protect the ecological integrity of the estuary. As such, it should take advantage of knowledge and methodology derived from historic, current and evolving research and management techniques. Therefore, while estuarine management should correctly protect the estuary from a wide variety of natural and man made damage vectors, it should at the same time

allow acceptable practices formulated to rehabilitate wetlands to be incorporated into its regulatory framework.

To put it in another way, the primary thrust of regulation is protection; the goal of management is utilization. Regulation, therefore, should allow maximum utilization within the bounds of sound conservation parameters, and should in no way prohibit by its protective language cogent, acceptable wildlife management practices.

DNERR should embark upon a continuing study of this regulatory process. It should periodically suggest changes which it feels are needed to enhance the efforts of resource agencies whose job it is to protect and manage the Delaware estuary. While the doctrine of not tampering with the regulatory process for fear of losing out to those who would do further damage to it may seem commendable, such a philosophy jeopardizes the efforts of responsible biologists whose job it is to manage this resource in the most efficient, up to date manner.

Open Marsh Water Management

Open marsh water management represents probably the newest and best in the continuing development of estuarine management practices designed to achieve specific conservation goals. In this scenario marsh tracts are mapped and mosquito breeding areas delineated. These sites are then excavated to minimal depth and the spoil sprayed onto the surrounding wetland. Spoil deposited in this amount and manner brings about no change in marsh surface elevation.

The end product is a crazy quilt pattern of slough and marsh where man-made drainage systems have been interrupted, biological mosquito control achieved, and sheet water restored, making the area once again highly attractive to waterfowl, waders and marsh birds. The estuarine ecology has been enhanced, and the marsh restored to a more historic condition.

DNERR should continue to investigate this technique in an effort to refine and expand its capabilities, making it adaptable to a wider variety of wetland situations.

Phragmites Control

In addition to or in concert with the monitoring project described above, DNERR should investigate additional and alternative methods of controlling this pest plant in an attempt to improve upon existing control efforts. The goal of this project should be to ultimately devise an efficient, economic method for achieving control on a statewide basis.

Continuing Development of Water Management Techniques

The key to marsh management lies in the development of biologically sound water management techniques. The wetland plant community is a function of its water quality, quantity and level, on a time period. Just as man and nature-induced changes in the water regime of a given wetland may produce harmful results, so may man induced practices restore once viable marshes.

Over the years, wildlife managers have developed a variety of approaches to wetland problems in their continuing efforts to improve and protect these valuable natural resources. These have included dikes, water control structures, open marsh water management, "soft" herbicides and pesticides, burning, impounding, and others.

DNERR should continue to investigate the general field of water management in an effort to improve existing methods and to devise new ways to manage and control water levels, water quality and water quantity.

Snow Goose Management

The snow goose problem has been discussed above under "Monitoring". In addition to following the annual wintering activities of this bird and noting its population level and dispersion, we must attempt to devise management techniques designed to curtail the wholesale damage incurred when great flocks descend upon and strip large tidemarsh areas of all vegetation. The goal of this management should be one of protecting the fragile ecology of feeding wetlands, while at the same time allowing this species to reasonably meet its overwintering needs - a tall order, indeed.

Harvest management, diversion to picked grain fields and scare tactics are among the options now available to and being employed by wildlife managers. It is obvious, however, that additional efforts and devices must be utilized to ultimately solve this problem, and DNERR should partake in this process.

INFORMATION AND EDUCATION

Traditional and Non-Consumptive Uses

Among the NERR projects Delaware offers - along with the usual array of estuarine research and educational activities, especially in the lower St. Jones sector - is its deep-rooted historical involvement. The St. Jones patents are some of the oldest in the United States, representing the likes of Caesar Rodney and John Dickinson, the "penman of the revolution". The Dickinson mansion and plantation have been preserved and restored by the Division of Historical and Cultural Affairs, a project which continues to this day and represents and important adjunct of the core area. These tidemarsh farms have been tilled, hunted, fished and trapped for over 300 years, and the area today looks not unlike it did in the colonial period. St. Jones neck has sustained little of the explosive development that the rest of the State of Delaware has experienced. A NERR project on this site can help provide protection not only to an important estuary, but to a most significant historical resource as well.

Because this area has been hunted, fished and trapped for so long it presents an excellent opportunity to study the relationship of these traditional activities vis-a-vis today's more non-consumptive oriented attitudes. Not only the relationship, but the problem of how these at times opposing viewpoints may be reconciled, makes ideal grist for this unit's mill.

The management of the St. Jones core area is a case in point. The tidemarsh here has traditionally been hunted and trapped. Will these activities continue as part of DNERR? Will the option of restoring historically drained ponds and sloughs through open marsh water management be exercised? Will the core area be made a sanctuary and additional ponds created on adjacent cropland be provided as alternative harvest zones? How will traditional and non-consumptive activity schedules mesh?

All of the above options are viable to various degrees; some will undoubtedly be considered, along with others, in the core area management plans. And all will have to satisfy a widely divergent, but not necessarily incompatible, set of parameters.

The DNERR project provides an excellent opportunity to study how deeply rooted, historical traditional uses may be merged with more modern, non-consumptive attitudes to obtain a viable, ecologically oriented estuarine research, management, and educational program. In addition, the effect of public use upon private land - a problem becoming more commonplace because of today's escalating population and the pressure it puts on a dwindling land resource base - may be addressed and, hopefully, a workable solution developed.

Conclusion

The DNERR project represents an opportunity to carry out estuarine research, management and education in an environment of considerable historical significance.

Environmental degradation, both natural and man made, has along with its detrimental effects on soil, water and air, not spared the tidemarsh which has been such an integral part of the Delaware estuary. Today's burgeoning human population has exerted additional stress upon the state's choice wildlife habitat. State and federal wildlife authorities recognized the impending danger over half a century ago and began to acquire strategic wetlands, ponds and wildlife areas in an attempt to protect these valuable resources. The prime movers in this venture, until recently, were the traditional users of the area - the hunters, fishermen and trappers - who provided the necessary funding through self imposed taxes on sporting goods.

In addition, innovative management and development practices have been designed in order to restore and reclaim despoiled wildlife habitat. The implementation of these practices has, over the years, resulted in the restoration of many degraded wetlands; been a boon to waterfowl and wading birds; provided efficient mosquito control within ecologically acceptable parameters; helped reduce phragmites infestation; protected indispensable shorebird migration routes; enhanced muskrat habitat.

It is ironic and unfortunate that long overdue and needed environmental protection regulations have, when finally enacted, discouraged and in many cases prevented the implementation of many of these wildlife management practices. Wildlife and marsh managers need to be able to continue the good work they have done

in the past - these activities must not be jeopardized by regulations designed to protect the estuary from destructive agents. We can, and we must... manage the marsh... and protect the estuary.

Anthony Florio
Wildlife Consultant
Dover, Delaware
March 1991